European Union Neighbourhood Instrument for the Republic of Moldova

PRELIMINARY BRIEF FOR THE CONSERVATION AND REHABILITATION OF THE CIRCUS OF CHISINAU

17 March 2019

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The present report has been prepared by Prof. Ing. Lorenzo Jurina, ing. Edoardo Redaelli, arch. Andrea Bassoli, with the supervision by the Resident Twinning Adviser, Luisa De Marco, as Input of Private Sector Under Activity 3.6 Implementation of the Pilot project as on-the-spot training.

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EXECUTIVE SUMMARY

The present report outlines the main aspects concerning the state of conservation of Chisinau Circus, based on the survey conducted by the team of experts – Lorenzo Jurina, Andrea Bassoli and Edoardo Radaelli – with the support of the Resident Twinning Advisor Luisa De Marco, and accompanied by technical staff of the CBM Programme – UNDP office in Chisinau, in 2019, February 20th-23rd.

Based on the visual inspections and on some rapid diagnostic tests performed by the experts during the training period, some critical situations of the state of conservation can be highlighted.

First, it must be noticed the complex structural geometry, due to the presence of a thick plaster and finishing that cover columns and beams.

For this reason, a geometrical survey conducted by means of a laser scanner is needed, even for comparing the real geometry with the original design drawings (available at URBANPROIECT).

Furthermore, constitutive materials need to be investigated through a deep diagnostic campaign, that has to concern with the reinforced concrete structures and steel elements, some of them partially hidden by the finishing. The residual mechanical properties of the investigated materials should bring the designer to determine the bearing capacity of the elements, starting from foundations up to the roof.

A numerical Finite Element Model can be a useful instrument to determine the global and local capacity of the Circus, subjected to vertical load (according to the current Standards) and horizontal seismic loads too.

The complete recognition of the structures can lead to a series of consolidation structural interventions, that need to be calibrated on the real necessity of the building.

In addition to the structural aspects, the global renewal of Chisinau Circus must take into account the heating and electric system, the fire system, the accessibility and the restoration of the decorated surfaces.

As described at the end of the present report, all the aforementioned activities require at least an amount of about 10 million euros.

Thus, since the task of the Twinning group concerns the identification of the priorities of intervention within the EU allocated funds amounting 1.8 million euros, which can cover only a part of the renovation process for the Circus, some priority interventions and diagnostic investigations.

AIM OF THE DOCUMENT

The present technical report refers to the ***Twinning Contract MD 13 ENPI OT 01 16*** *"Support to promote cultural heritage in the Republic of Moldova through its preservation and protection"Input of private sector - Activity 3.6.*

The contents hereafter described are based on the activity conducted by the authors (prof. Eng. Lorenzo Jurina, Eng. Arch. Andrea Antonio Bassoli and Eng. Edoardo Oliviero Radaelli) in Chisinau (Republic of Moldova) during the training period in 2019, February 20th-23rd and at home in the following period.

Aim of the technical report is to outline the design process to be described in an international contest for the repair and restoration works of the Chisinau Circus, leading the owner to a conservative project, respectful of the existing building and, at the same time, able to guarantee the safety criteria required by the National and International Standards.

EMERGENCY INTERVENTIONS

Securing operations for the facades

During the survey a very critical condition of some marble tiles was detected. Some elements were already detached while some other were near to collapse in an area open to public.

For this reason, a securing operation of the facades is strongly recommended and mainly it will consist in:

1. Detailed analysis of the facades, by using an elevator; the operation will consist in mapping the degraded elements, taking pictures and sketching of the most evident cracks and detachments.
2. Evaluation of the adherence of the marble tiles by using a soft hammer; if the tile sounds "empty", the panel needs to be numbered, detached carefully and stored.
3. Marble tiles must be conserved in a safe place for the final restoration intervention.

It is strongly suggested to do the intervention as soon as possible to prevent further damages.

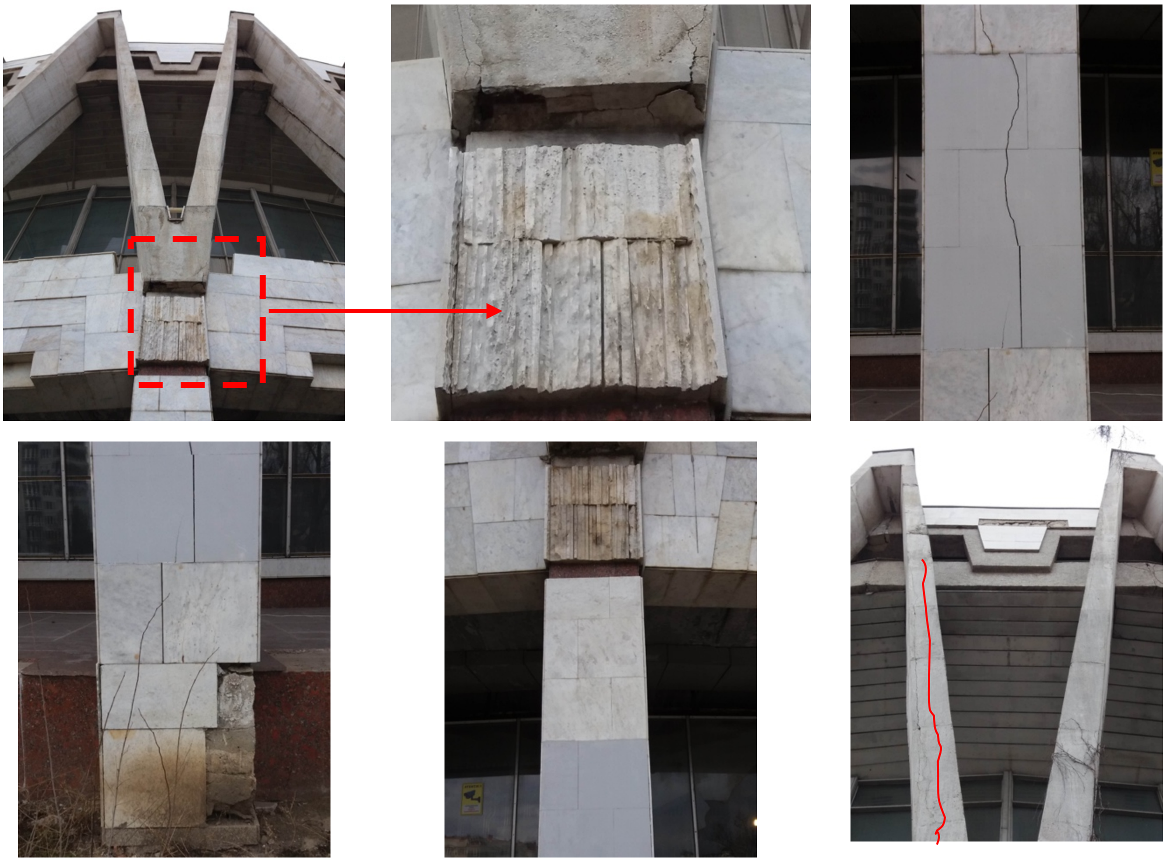


Figure 1: Detachment of marble panels from the facades

Securing operations for the broken windows

The temporary closure of broken windows with wooden panel is strongly recommended, to prevent damages to internal decorations. In particular, it must be highlighted the window near the stair, where the sculpture present on wall is subjected to severe weather.

This must be considered as a provisional intervention, waiting for the final repair of the windows.

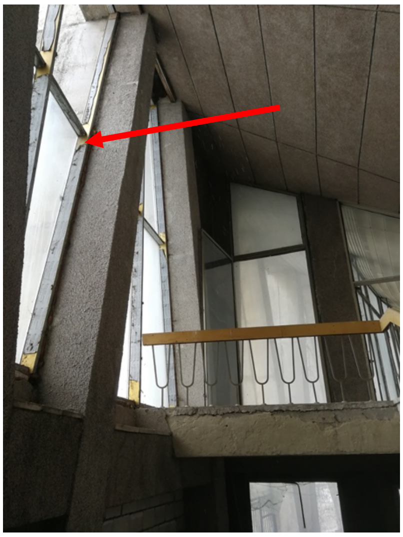


Figure 2: Broken window

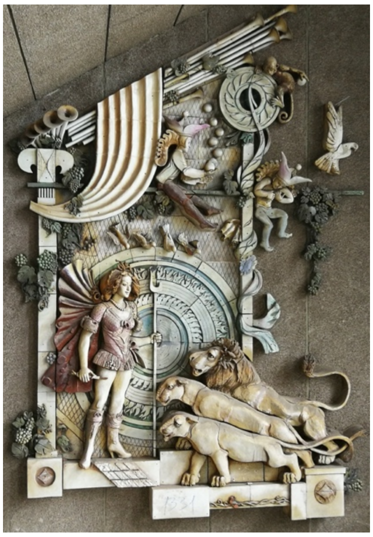


Figure 3: Sculpture exposed to severe weather

Preliminary assessment of priority of intervention

For the first tranche of EU investment, the following steps should be considered:

a. collecting all the documentation and information about the original project and the current state of conservation of structure. It means to perform a diagnosis campaign on geometry and materials through destructive and non-destructive tests to be done in situ and in laboratory, as described in the following paragraph 6.2.3. Survey and reliefs need to be carried out on structures (column, beams, floor, roofs), surfaces (internal and external) and on technical installations. All the information collected should be returned through drawings containing plan views, sections and fronts.

b. Numerical FE modelling of the structures, adopting the information collected in the previous step (a) as input data. According to the results obtained by the numerical analysis, the structural local and global vulnerability can be assessed. After having chosen the level of static and seismic retrofitting, the consolidation interventions can be calibrated.

c. Based on the survey conducted by the experts on February 2019, the following interventions can be identified as priority:

1. Reparation of the cover in order to avoid any further water infiltration.

2. Passivation and protection from corrosion of the exposed steel elements and steel r.c. exposed bars (outside frames).

3. Passivation and protection from corrosion of the exposed steel elements and steel r.c. exposed bars (inside frames).

4. Passivation and fire protection steel elements and steel r.c. exposed bars (inside frames).

5. Integration of missing doors and windows, similar to the one adopted in recent years.

6. Installation of electrical system and emergency exit to use the foyer for small exhibithions.

In the following paragraph 5.3 structural problems are illustrated, while in paragraph 7.1 interventions are detailed.

THE CIRCUS OF CHISINAU

2.1. The tradition of Circus in Soviet period

The circus was the most popular and most egalitarian stage art of the USSR that unlike theater, ballet or music, did not require any previous education. Their functions were cheap, simple and fun, they did not deal with existential issues if it was not for comedy. In many cities of the USSR and the allied countries fixed equipment was built, with local companies or visitors and are among the contents that have best survived the political and social changes. Contrary to its nomadic origins, which continue to be its way of working in the rest of the world, in the socialist countries the circus was a fixed cultural reference that was in the middle of the urban center even on the main avenue.

Like all Soviet institutions, the circus was nationalized in 1919, at the end of the revolution. In 1929 the circus school in Moscow was founded and in 1946 the study for clowns was introduced, forming the first public educational institutions in the world for the circus arts. Since 1957 the circuses of the entire Soviet Union have been managed by the state company Soyuzgostsirk (Union of Public Circuses) that came to build around 70 facilities until the fall of the USSR. The workers of the circus were part of the middle class: they had a carrerea, they were public employees and they also had benefits, because of the danger of the disciplines and because of the cultural interest that the circus had. From the time of “thaw”, after the death of Stalin, several circuses of the USSR and especially the one of Moscow, did tours and offered functions in Western Europe, something that placed its workers above the average of the public officials.

The functions of circus were daily, in the big cities were made two a day and were designed for everyone, regardless of age, education, economic level or position in the civil service system. By never reaching the theoretical ideal, Soviet society was not as egalitarian as is often thought, so that the circus was the socially most cohesive artistic form. It is a collective art in every sense: there is not a single author, the performances are created during the training process by their actors and all contribute to the success of the company equally. The creation of the pieces – of acrobats, jugglers or tamers – involves overcoming the limits of one’s own body, competing with oneself, with nature or with peers. The circus unites art with sport, science and mechanics and in this is in line with the imaginary of communist ideology.

The specificity of the Soviet circus, heir to the Russian circus with influences from the Far East, is the introduction of a narrative line. It is not a simple display of skills, but all the pieces, in one way or another, unfold around a common thread. This characteristic, together with the popularity of the expressive form, has contributed to the fact that circus is also the ideal medium to transmit a slight ideological message. During the Second World War, the Moscow circus, now known as the old circus or the Nikulin circus, did not stop the performances. The stunts included motorcycles and weapons, the clowns were dressed in German soldiers to ridicule them and at the end of the show a tank entered to destroy some sad enemy.

The circuses that have been built in the Soviet Union have very little changed their original form. All are round and in their outer form reminiscent of the canvas tents of circuses we know.

The origin of the circus in tribal rituals and group military exercises dictated this initial form that was modified in Roman times to include other types of competitions and that returned to its origins in the Renaissance to give rise to the modern circus. The form is dictated by the physical characteristics of the performances: the acrobatics unfold freely in space, they must be able to observe from any point equally. They do not need any scenery that would fix them in a specific stage. The same goes for numbers with animals: they walk in circles, look at each other and do their performances together. Or the clowns, jugglers and the rest.

The evolution of the Soviet circus as an architectural form has had two main aspects: the technological progress of the scenic machinery and the changes of external form that has been parallel to the changes in Soviet architecture in general. In terms of technology, circuses have been accumulating lateral spaces, training and preparation rooms, controlled areas for animals, etc.

The new circus of Moscow opened in 1971 and considered the largest circus in the world with capacity for 3,400 spectators, has 5 arenas: equestrian, water, illusionist, ice rink and lighting effects, located on platforms up to 18m underground, which can be exchanged during the function.

Most of the Soviet circuses were built at the end of the Second World War and after the first and necessary wave of construction for industry, housing, administration and monuments. Many replaced the old wooden circuses or were placed in places where the visiting companies usually raised their tents.

The only building that survived the war that was the St. Petersburg circus, opened in 1877 as the first fixed circus of the Empire. Its neoclassical façades were simplified in the 1959-1962 reform, not to be out of sync with the architecture of socialist realism promoted by Stalin since the 1930s. The "national in form, socialist in content style", as socialist realism was defined - with the national form based on the neoclassical model- continued to be used beyond the XXth Congress of the CPSU (1956) and criticisms of the Stalinist monumental excesses.

Many of the projects were already decided or started, but they were slow to execute, so neoclassical forms share the circuses of Minsk, Tbilisi, Kiev or Yerevan, all built in the late 50s or early 60s.

In his famous speech at the National Conference of builders, architects, workers in the materials, construction and road and bridge machinery and employees in organizations for the development of design and research, December 1954, Nikita Khruschev (1953-1964) claimed a more efficient and economic use of materials and construction elements, insisted on the production of spaces with prefabricated elements and on the rationality and functionality of the form.

The manual building with bricks, the profuse and unjustified decoration and the excessive weight of the structural elements were central themes of this call for the change of architectural paradigms that came to be identified with a return to modernism or pre-war avant-garde. The most rationalistic circuses, such as those of Kazan, Novosibirsk, Donetsk, Kharkov, Stavropol or Volgograd, built in the second half of the 60s and the first of the 70s are clean forms with large opaque or transparent surfaces, with lightweight structure elements and prefabricated.

The circus that marked trend was the new circus of Moscow or Bolshoi circus, of 1971 that introduced a spectacular dome, with metallic finish of 36m of height, similar to the domes of sports halls or of exhibitions built in other socialist countries in the same time. A precedent *was also the Circus Globus of Bucharest of 1960 of architects N. Porumbescu, C. Rulea, S. Bercovici and N. Pruncu.*

From the mid-70s, coinciding with the economic stagnation of the Brezhnev era (1964-1982) and the flight forward of representative architecture, Soviet circuses were built with increasingly spectacular forms and decorations.

The circuses of Chisinau, Dnipropetrovsk, Dushanbe, Kislovodsk, or Yekaterinburg have the most elaborate forms or details. This era corresponds to the criticism of the formal austerity of the Khrushchev era, the development of dream forms and the return of decoration based on national motives. This national and abstract stamp, made of prefabricated elements, carry the circuses of Tashkent, Almaty, Karganda, Nizny Novgorod or Baku.

The Soviet circus | arch. Jelena Prokopljević, 2014

https://veredes.es/blog/en/circo-sovietico-jelena-prokopljevic/

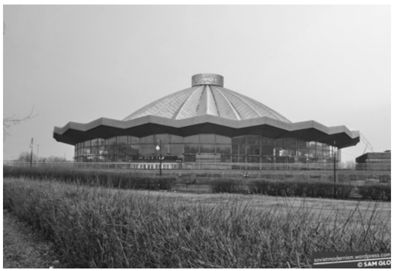


Figure 4: Moscow State Circus

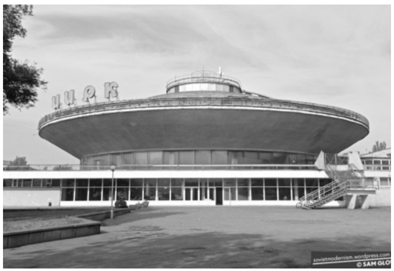


Figure 5: Zaporozhia Circus, Ukraine

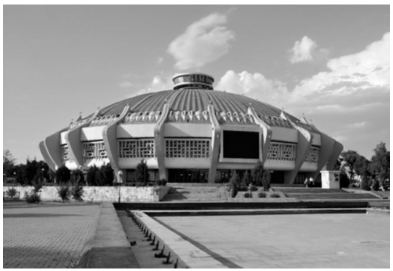


Figure 6: Circus of Tashkent

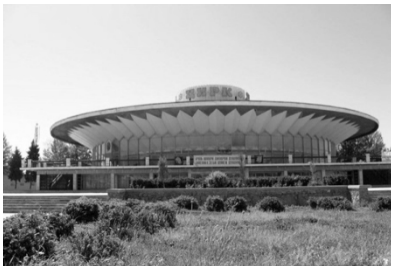


Figure 7: Circus of Dushanbe

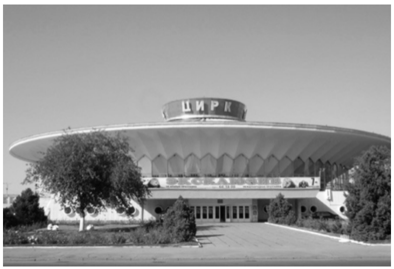


Figure 8: Circus of Bishkek

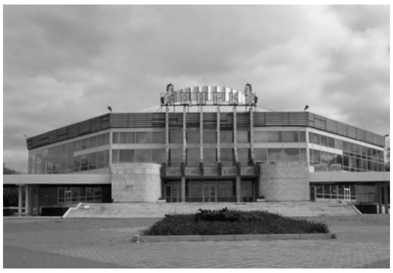


Figure 9: Circus of Omsk

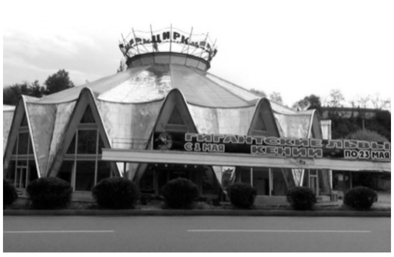


Figure 10: Circus of Kislovodsk

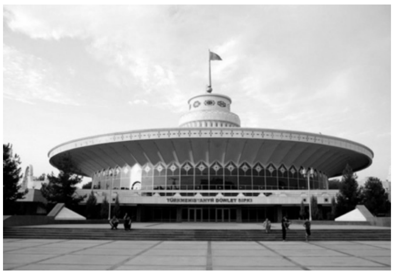


Figure 11: Circus of Ashgabat

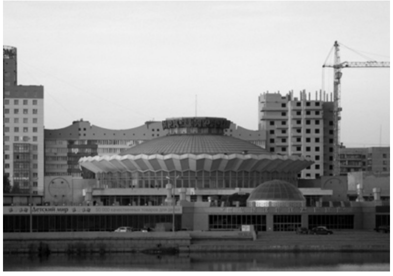


Figure 12: Circus of Chelyabinsk

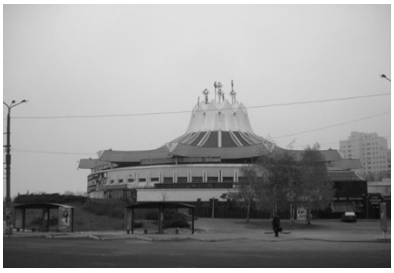


Figure 13: Circus of Dniepropetrovsk

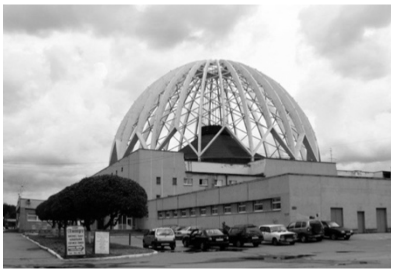


Figure 14: Circus of Yekaterinburg

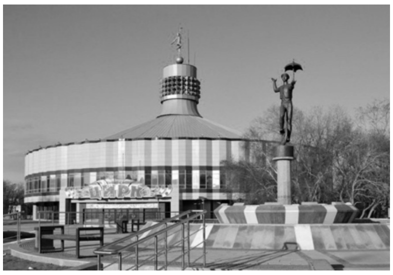


Figure 15: Circus of Karaganda

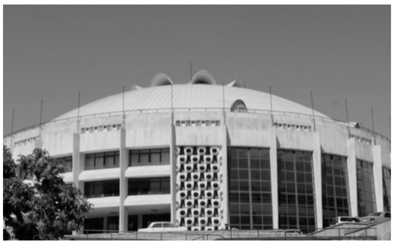


Figure 16: Circus of Baku

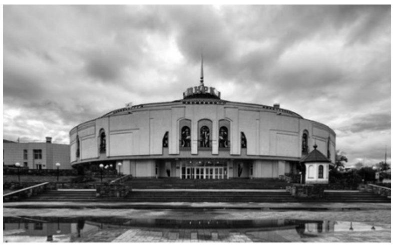


Figure 17: Circus of Novgord

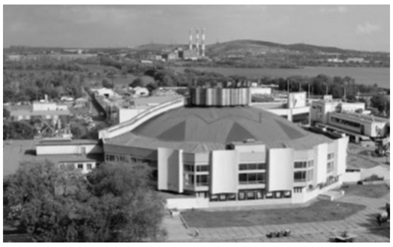


Figure 18: Circus of Magnitokorsk

The Circus in Chisinau: from its origins to its current conditions

The Chisinau Circus is located in Bulevardul Grigore Vueru (E584) , between Stradela Pietrarei 2 and Strada Circulu, as identified in the following maps.

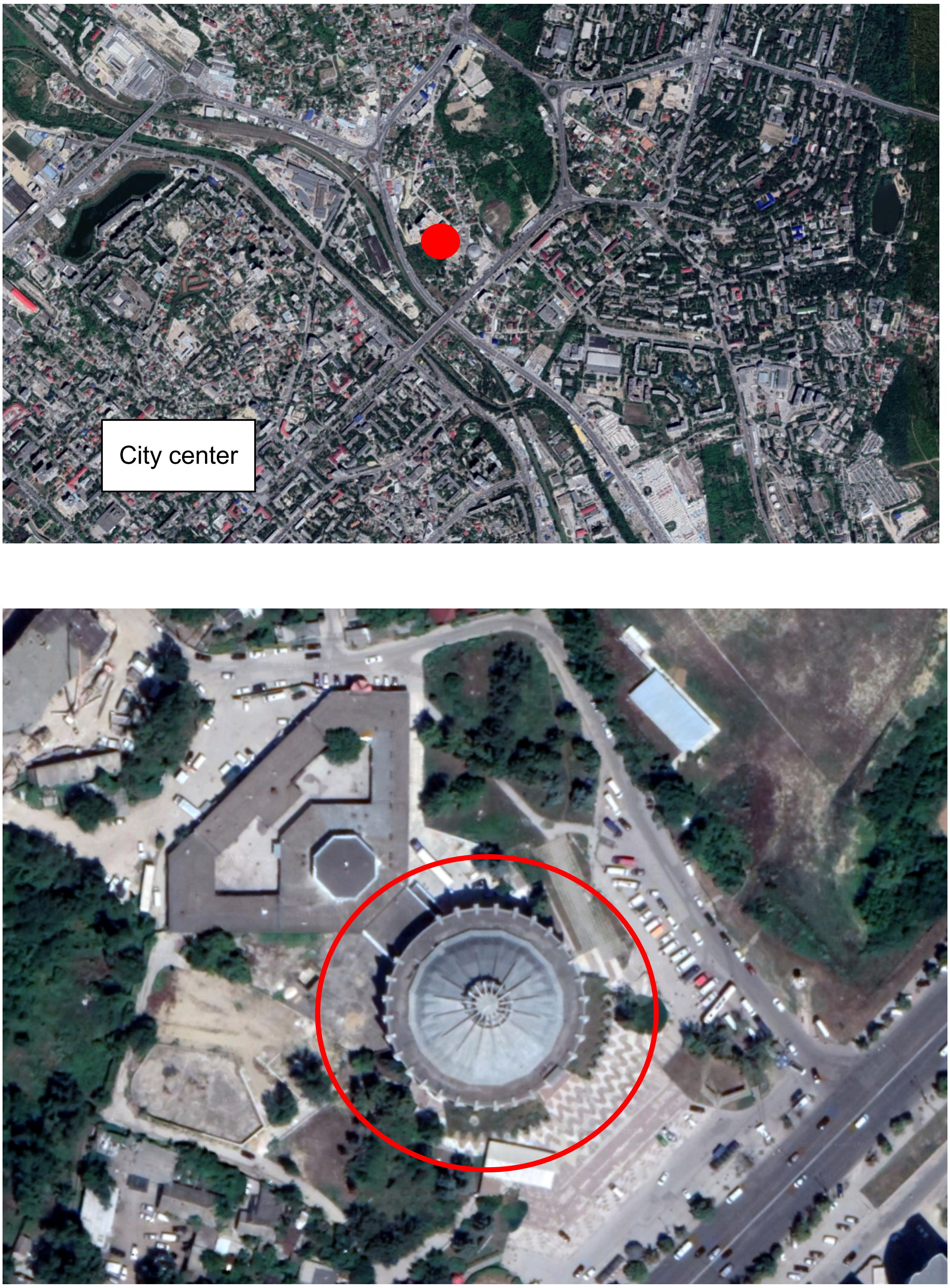


Figure 19: Satellite view of Chisinau and of the Circus

The Chisinau Circus construction started in 1978. Designed by the architects Ala Kirichenko and Simion Shoyhet and engineers A. Snipelishsky, T. Grryunov, the Circus took the architects three years to create the design, from 1965 to 1968. The project was innovative and risky, considering that from the beginning, conflicts erupted between the sponsors “Союзгосцирк” (the Circus Union of USSR) from Moscow and the design team from Chisinau.

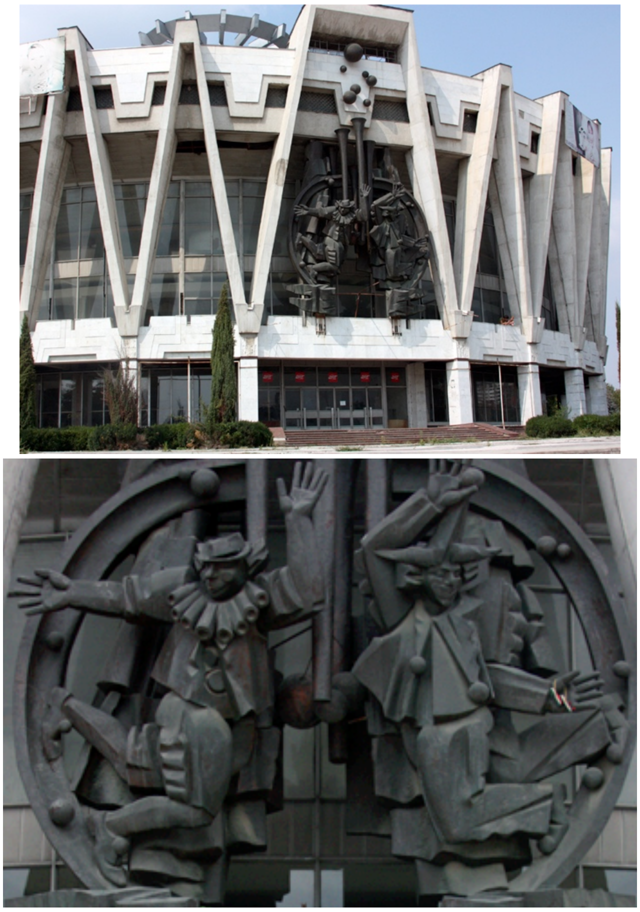
Originally, the building was designed as a monolith, but when it became clear that the allocated funds were insufficient, the group decided to use prefabricated structures. Nevertheless, Chisinau State Circus was opened in 1982.

The funds required for the construction were allocated from the budget of the USSR as a gift for the celebration of 545 years since the first mention of the Chisinau city. The authors of the project were awarded the State Prize of the MSSR.

In 1988, a large sculpture group created by the sculptor Matvey Levinson was installed above the main entrance. The sculpture presents the image of two clowns – acrobats, who greet the visitors with a smile. This carve was included in the Register of Protected Monuments of the Republic of Moldova in 22nd of June 1999, as approved by the Parliament.

In Figure 7 the sculpture at the beginning of the Nineties, while in Figure 8 the current compromised state of conservation.

1.



2. Figure 20: Sculpture over the main entrance at the beginning of the Nineties

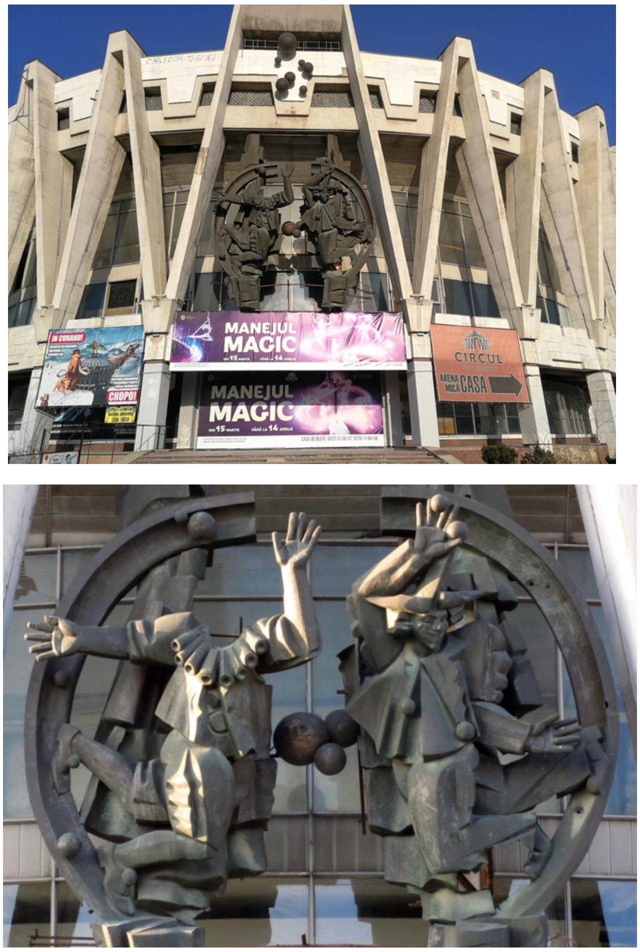


Figure 21: Sculpture in 2019, seriously compromised

The Chisinau State Circus has hosted concerts and performances of both local and international artists (Belarus, China, Finland, Germany, Russia, Ukraine, etc.). Although the other circuses of the former Soviet bloc were having up to 14 performances per year, the Chisinau Circus used to hold the record with up to 57 shows a year, with a staff of about 60 people.

After the collapse of the USSR, the circus' activities have continued at a slower rate. Since 2004 the Chisinau Circus has stopped its activity due to the need for renovations. In 2006 the Circus was listed on the stock market, following a decree of the Ministry of Culture and Tourism.

In 2008 a usufruct contract was signed for a period of 29 years involving the Cypriot company "Pesnex Developments Limited". The commercial operator was bound to take on the restoration and maintenance expenses, but failed to honor its contractual obligations. In March 2011, the 2008 contract was declared invalid by the Economic Court of Appeal, therefore the circus returned to Moldavian state ownership, but remains in an advanced state of deterioration.[1]

3.

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[1] Socialist Modernism platform - B.A.C.U.- http://socialistmodernism.com

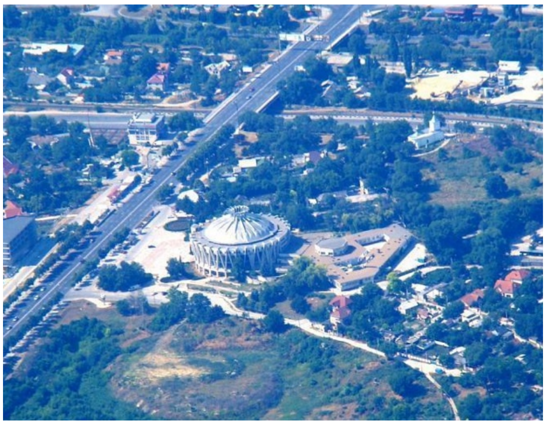


Figure 22: Aerial view of the Circus in a picture of 80s

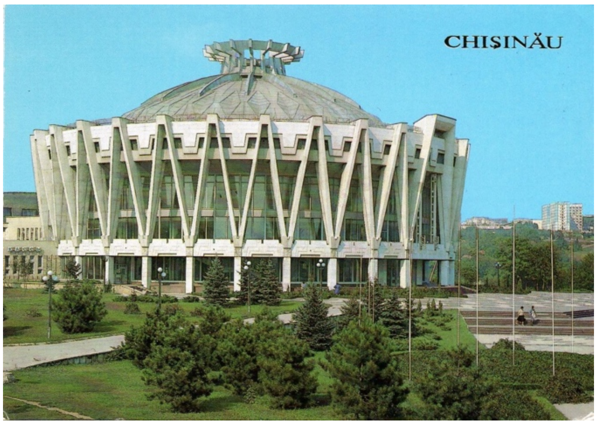


Figure 23: a postcard of Chisinau

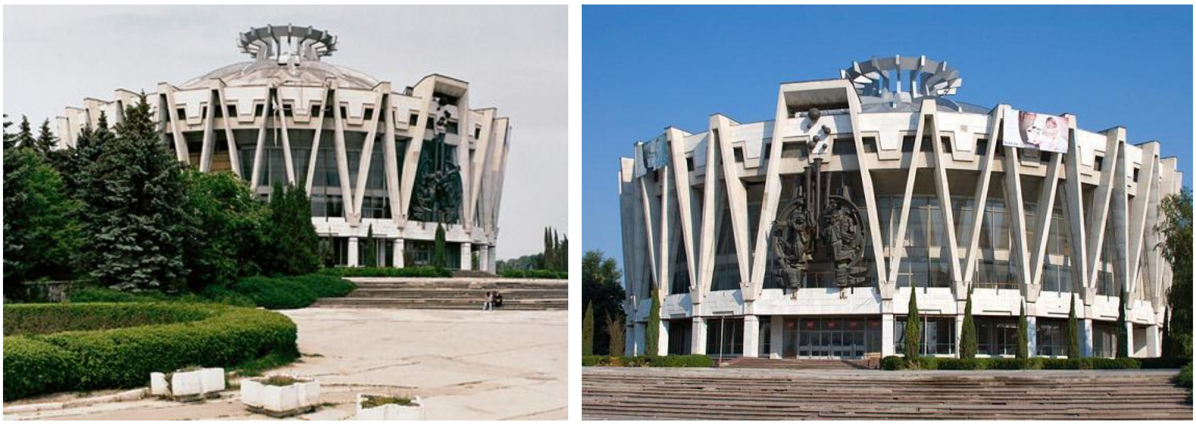


Figure 24: Main entrance of the Circus after the opening

State of conservation of the Circus

The present chapter contains the main results of the survey activity, conducted on-site by the experts, in February 2019.

Aim of the on-site activity was to obtain a general overview of the building, collecting some basic information about geometry, material and loads, which have to be integrated with a deeper diagnostic activity in order to develop the future design project.

Historic documentation

For the purpose of a correct identification of the building, in terms of structural elements, finishing, and technological system, it is always important to reconstruct its entire constructive history, mainly focusing on the construction process and the subsequent modifications during its life.

In particular, the position of joints, of possible discontinuity, of material inhomogeneity and of structural vulnerabilities, both in plan and elevation, need to be identified and highlighted.

The history of the building can also be used as a check tool to compare the real and modeled responses to a particular event (either natural or anthropic), as earthquake, settlement, additions and transformations.

Concerning the Chisinau Circus, the original drawings were examinated thanks to the kind availability of the "Agenția Proprietatii Publice a Republicii Moldova – Institutul National Cercetari si Proiectari URBANPROIECT" and of its Director Eng. Vladimir Carlov.

Some other information about the construction technique and details of the project were discussed with architect Ala Kirichenko, thanks to her kind availability in meeting the experts during the training.

Despite the external appearance, the structure is partially in steel and partially monolithic, in reinforced concrete, as can be seen by the following historic pictures, taken during the construction phase.

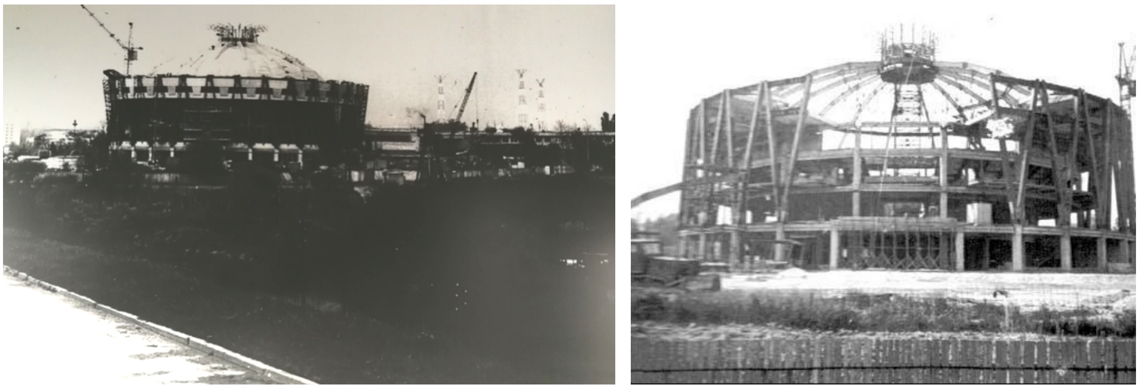


Figure 25: Chisinau Circus during the construction phase

Foundations are characterized by r.c. continuous beams, with a trapezoidal shape.

Two rings (one is perimetral, another one is about 4.5m offset from the previous) are connected each other by 16 radial beams, with an enlargement in correspondence of the columns.

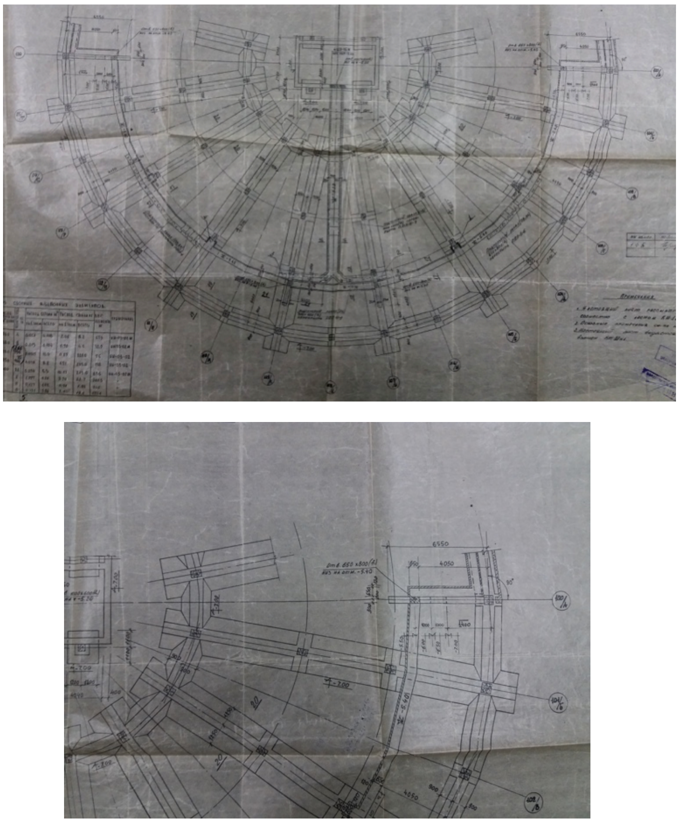
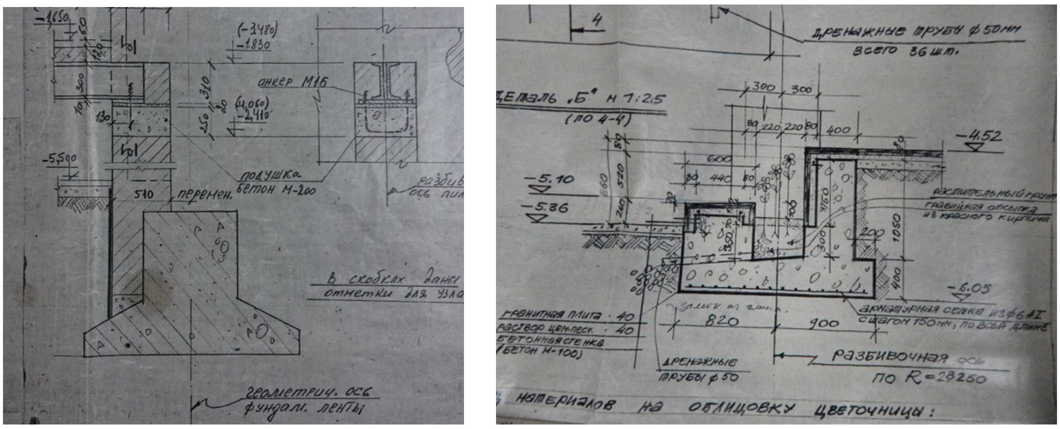


Figure 26: plan view of foundations, taken from the original project.


(-3480)
-1.830
анкер М16
(4,060)
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-5,500
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деталь „Б" М 1:2,5 (по 4-4)
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300
400
-4.52
-5.10
-5.36
растительный грунт
гравийная отсыпка из красного кирпича
-6.05
гранитная плита · 40
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бетонная стенка (бетон М-100)
820
900
арматурная сетка из ф6АI с шагом 150мм, по всей длине
дренажные трубы ф 50
разбивочная ось по R=28250
материалов на облицовку цветочницы:

Figure 27: Cross section of the foundation beams, taken from the original project

From foundation, r.c. columns support beams and slabs of the ground floor and the perimetric V-shape elements.

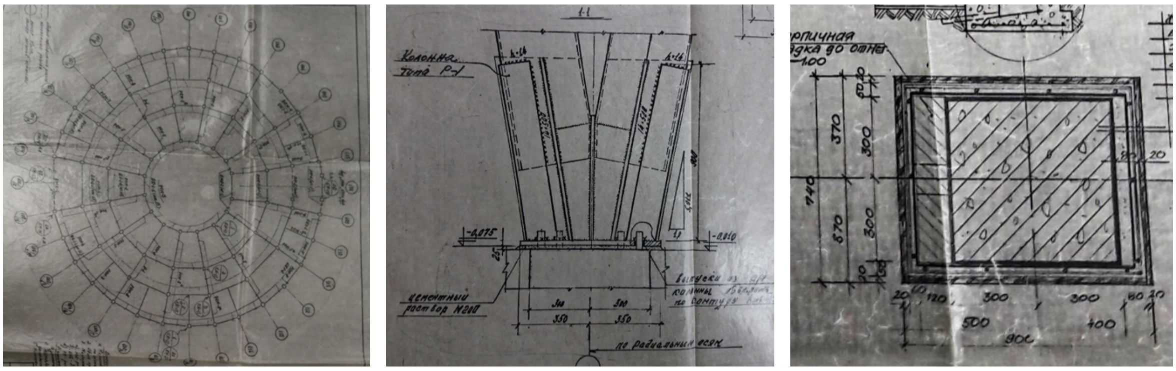

Колонна тип Р-1
цементный раствор М200
по радиальным осям
500
800
400

Figure 28: Plan view of the column position and detail of the connection between the head of the r.c. column and the support of the steel V-shape element and column cross section

As previously mentioned, the external V-shape structures are not made of concrete, but they consist in steel trusses, covered by a layer of concrete and by the marble tiles. The current solution is different from the one originally designed (a monolithic r.c. structure was though at the beginning) for a matter of elevated costs, as illustrated by architect Ala Kirichenko during the discussion.

The steel structure is accurately detailed in the consulted design drawing.

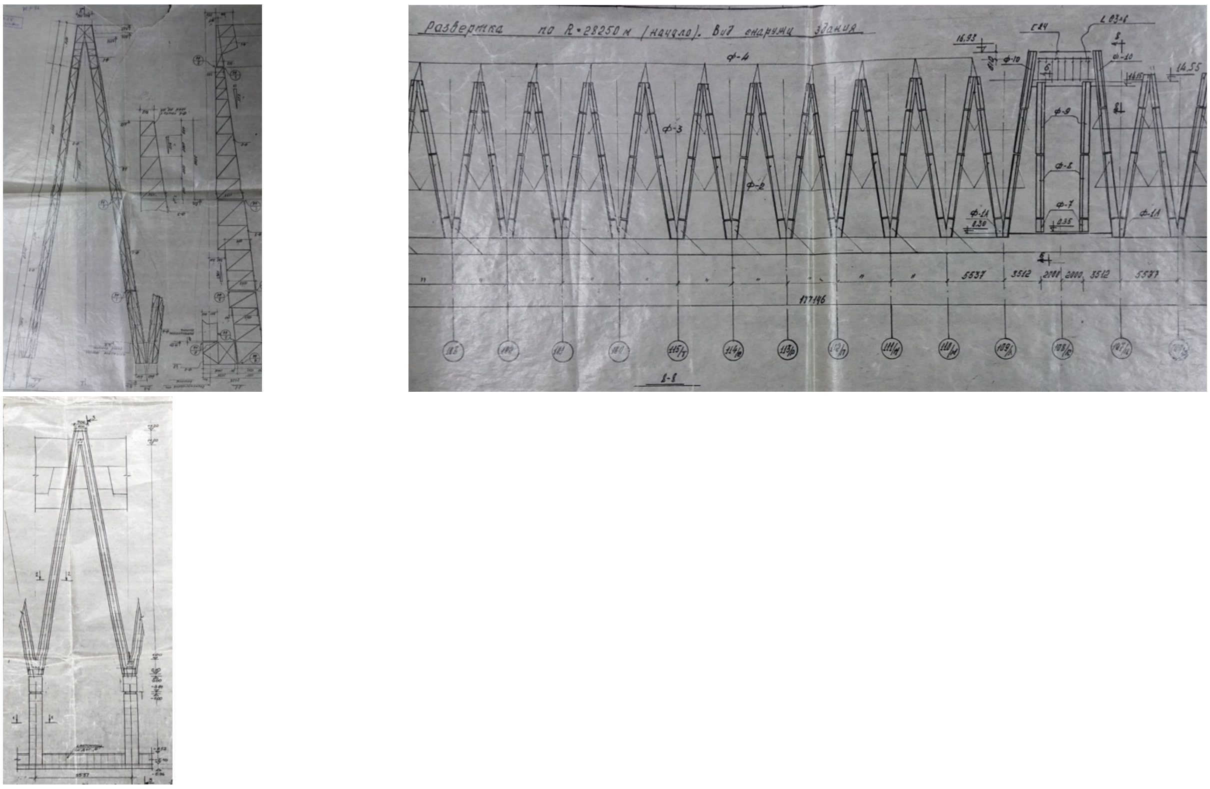

Развертка по R=28250 м (начало). Вид снаружи здания

Figure 29: V-shape steel elements

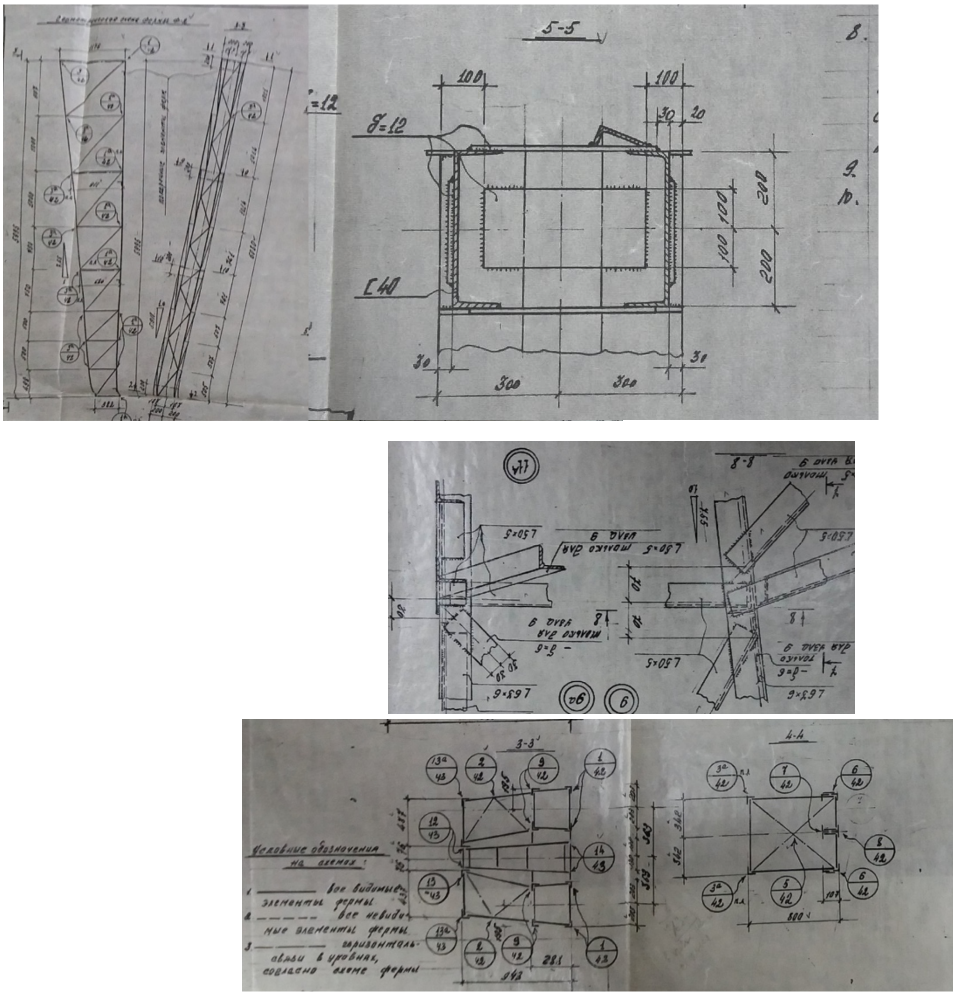
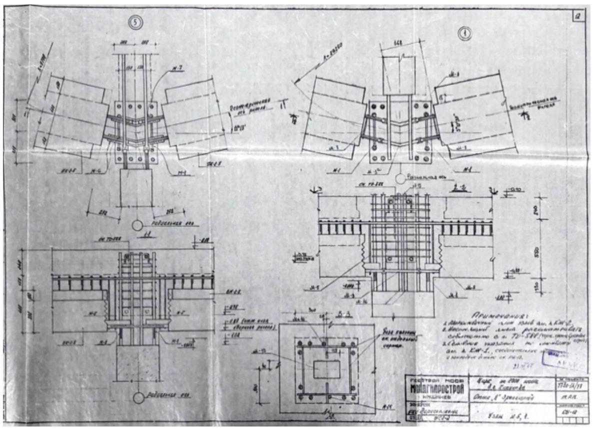
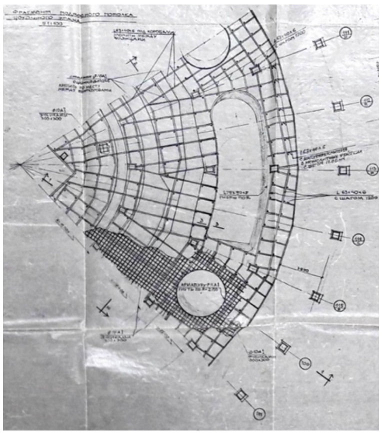

5-5
δ=12
[40
100
100
30
20
200
200
100
100
300
300
30
30
3-3
4-4

Figure 30: details of the V-shape elements

The inside structure is characterized by r.c. columns, steel or r.c. beams and pre-formed r.c. slabs, with cast in place connection between columns and beams.

Hereafter some drawings extracted from the original project.





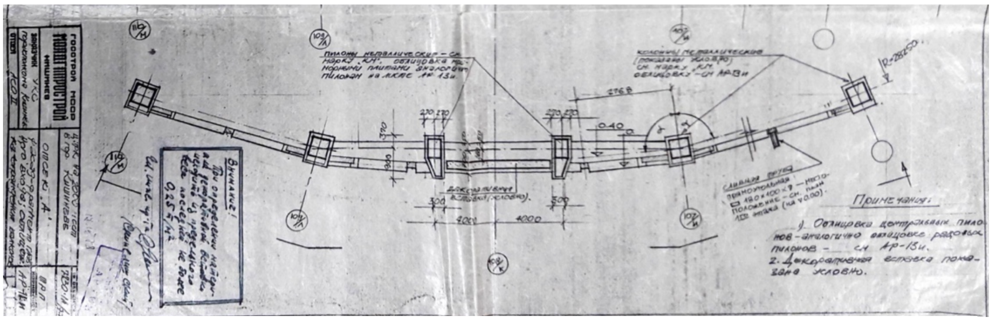


Figure 31: Details of the slabs and beam to column connection

Concerning the stairs, a structure composed by two principals steel beams and simply supported precast steps was detected during surveys and confirmed by the original drawings. At the level of lending a r.c. transversal beam works as an intermediate support for the two principal beams.

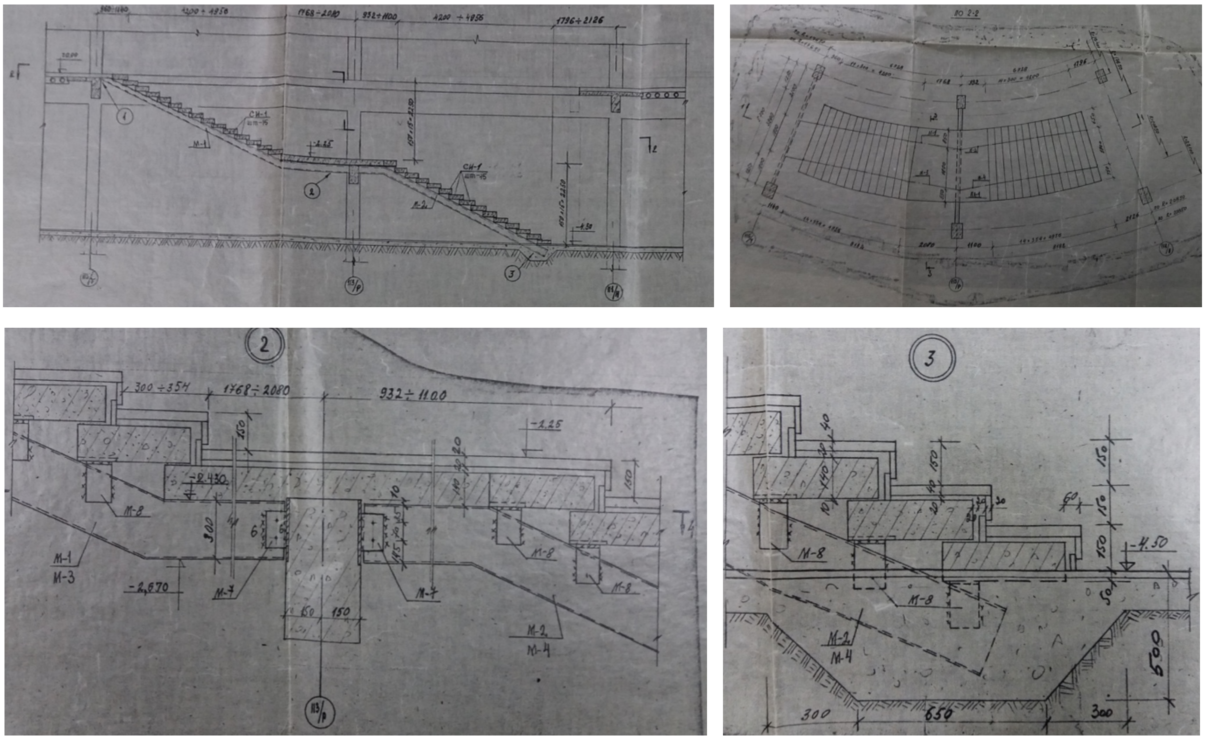


Figure 32: section, plan view and details of the stairs

The dome of the roof is made by steel principal beams, along the radial direction, supported by a r.c. ring in the lower part and a steel ring at the top. Secondary beams are positioned along parallels.

Connections are partially welded and bolted.

Only few bracing structures are present.

The finishing package of the roof is composed by a fibercement corrugated board, a layer of rock wool, a single wooden board and a galvanized steel cover.

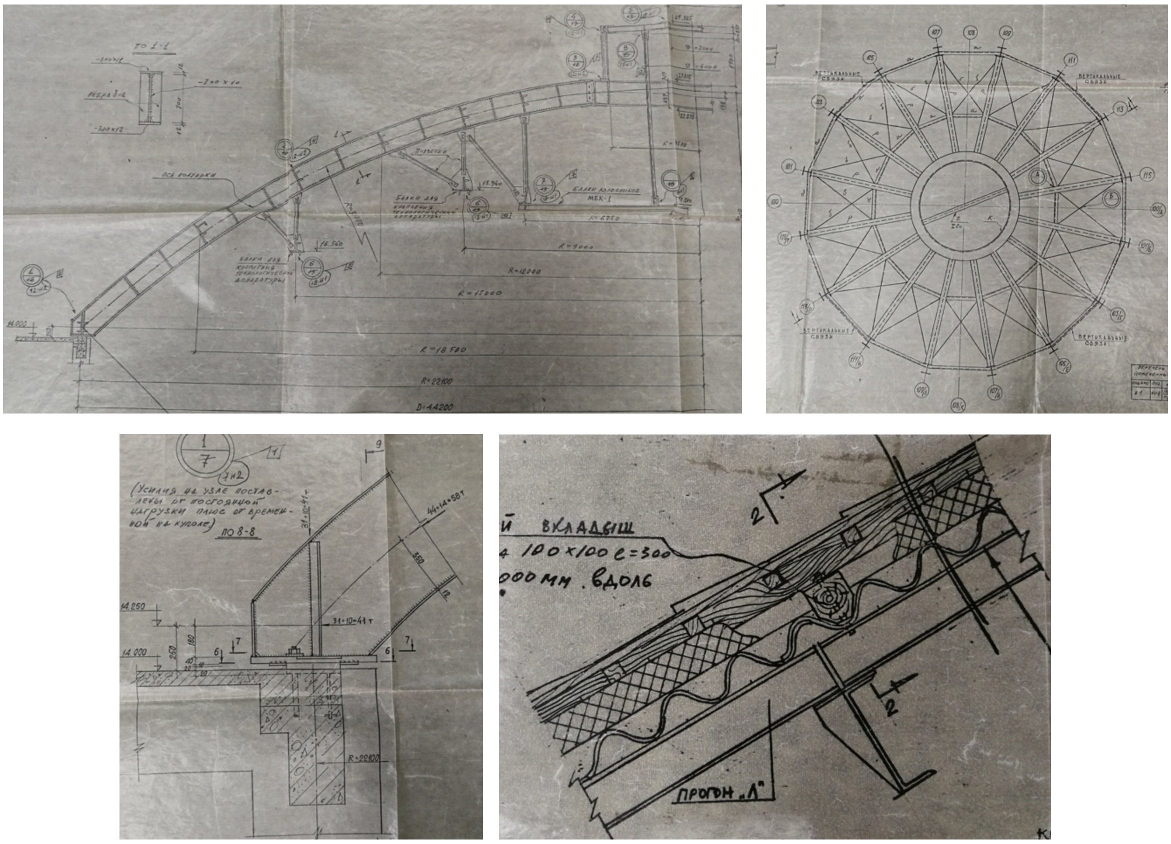

R=9000
R=12000
R=17000
R=18700
R=22100
D=44200
14.000
14.250
R=22100
31-10-41т
й ВКЛАДЫШ
4 100×100 ℓ=300
000 мм. вдоль
прогон „Л"
2

Figure 33: Cross section plan view and details of the roof

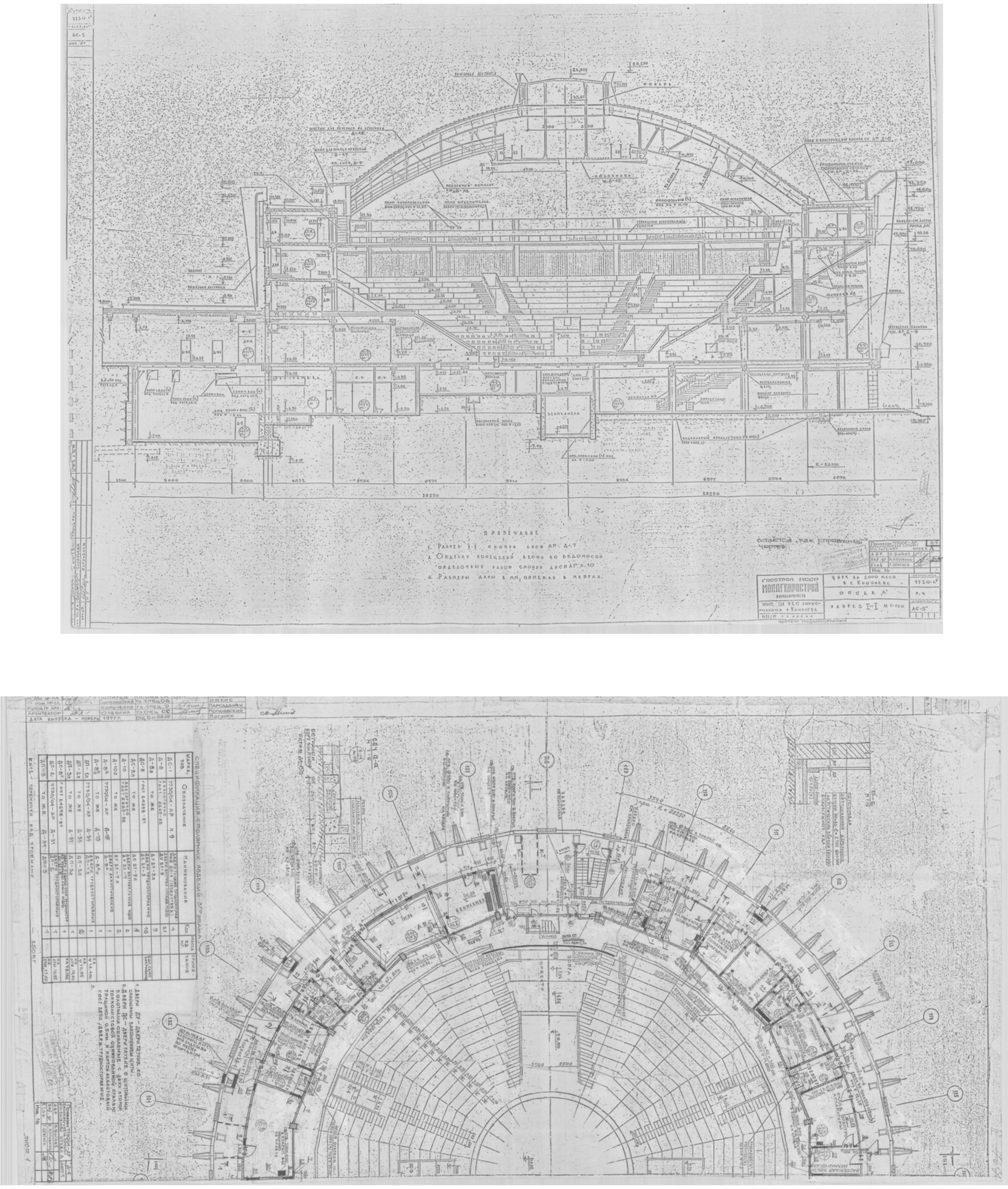


Figure 34: Plan view and cross section of the circus from the original drawing

Constructive material survey and mechanical characterization

The constructive material survey allows to identify the resistant system of the building, providing information about quality and state of conservation of materials.

This recognition needed for an appropriate project requires the acquisition of information that can often be difficult to obtain (under plaster, behind to false ceilings, etc.). This information can be obtained thanks to non-destructive investigation techniques either indirect (thermography, georadar, sonic tomography, etc.) or weakly destructive direct inspections (endoscopies, peeling of plasters, samples, small scale, etc.).

For the Circus, a certain number of direct inspections were performed during the training, in order to investigate the structural elements, through endoscopies, profometers and small removes of plaster.

Mechanical characterization of the concrete

A simple visual survey sometimes allows to reach a good knowledge of the structural behavior of the building and to identify the quality of materials and their degradation. In many cases, however, an adequate numerical model requires the knowledge of mechanical parameters of deformability and residual resistance of materials, especially in relation to seismic action.

The direct measurement of the mechanical parameters, in particular those of resistance, can be performed through weakly destructive tests, on limited portions.

Concerning to r.c. structures, sonic tests combined with sclerometer tests (which are non-destructive tests) can be performed diffusely, while samples obtained by drilling (which are destructive tests) can be limited to few structural elements, to be used as bench-marks.

During the on-site survey in Moldovia, some tests were performed on the r.c. structures of the Circus trying to obtain information on:

- the resistance of concrete (through sclerometer tests);
- the depth of carbonation (through phenolphthalein tests).

A "Salmoiraghi" type sclerometer was used for the sclerometer tests in order to obtain the correlation between the average rebound index provided by the sclerometer tests and the compressive strength value in kg/cm^2.

For all the measured points, the tests were carried out directly on the surface of the structural element placing the instrument horizontally and repeating 15 sclerometer beats for each element investigated.

As can be seen from the following table, the characteristic compressive resistance of concrete ranges from 30,9MPa to 46,7 MPa. It is important to observe that these values can be too favorable, as the presence of a carbonation depth should be taken into account in interpreting the results obtained with the sclerometer.

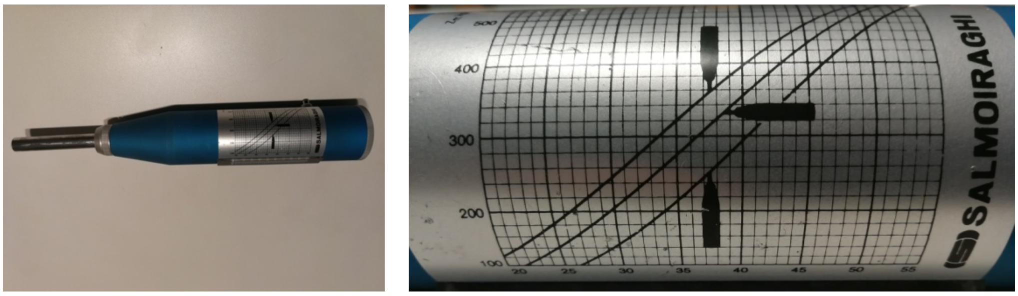


Figure 35: Cross section plan view and details of the roof

p1 ground floor		**p2_ground floor**		**p3_ground floor- ext**	
S1		S2		S3	
Rebound	Rck	Rebound	Rck	Rebound	Rck
43	40	46	45	45	44
38	32	45	44	47	47
32	24	52	52	46	45
34	26	46	45	43	40
36	29	42	38	54	55
36	29	47	47	44	42
36	29	53	53	53	53
34	26	42	38	44	42
34	26	42	38	46	45
32	24	42	38	42	38
41	36	44	42	53	53
38	32	42	35	46	45
45	44	40	35	55	56
40	35	40	35	53	53
38	32	39	33	44	42
Avarage	**30,9**		**41,2**		**46,7**

The **phenolphthalein indicator** solution was applied to a fresh fracture surface of concrete. If the indicator turns purple, the pH is above 8.6. Where the solution remains colorless, the pH of the concrete is below 8.6, suggesting carbonation. A fully-carbonated paste has a pH of about 8.4.

Hereafter, the results obtained on three tests conducted on site on the same three r.c. columns investigated through sclerometer are reported.

Tests were conducted by collecting the concrete powder obtained during a simple drilling operation (10 mm in diameter, 80 mm in depth).

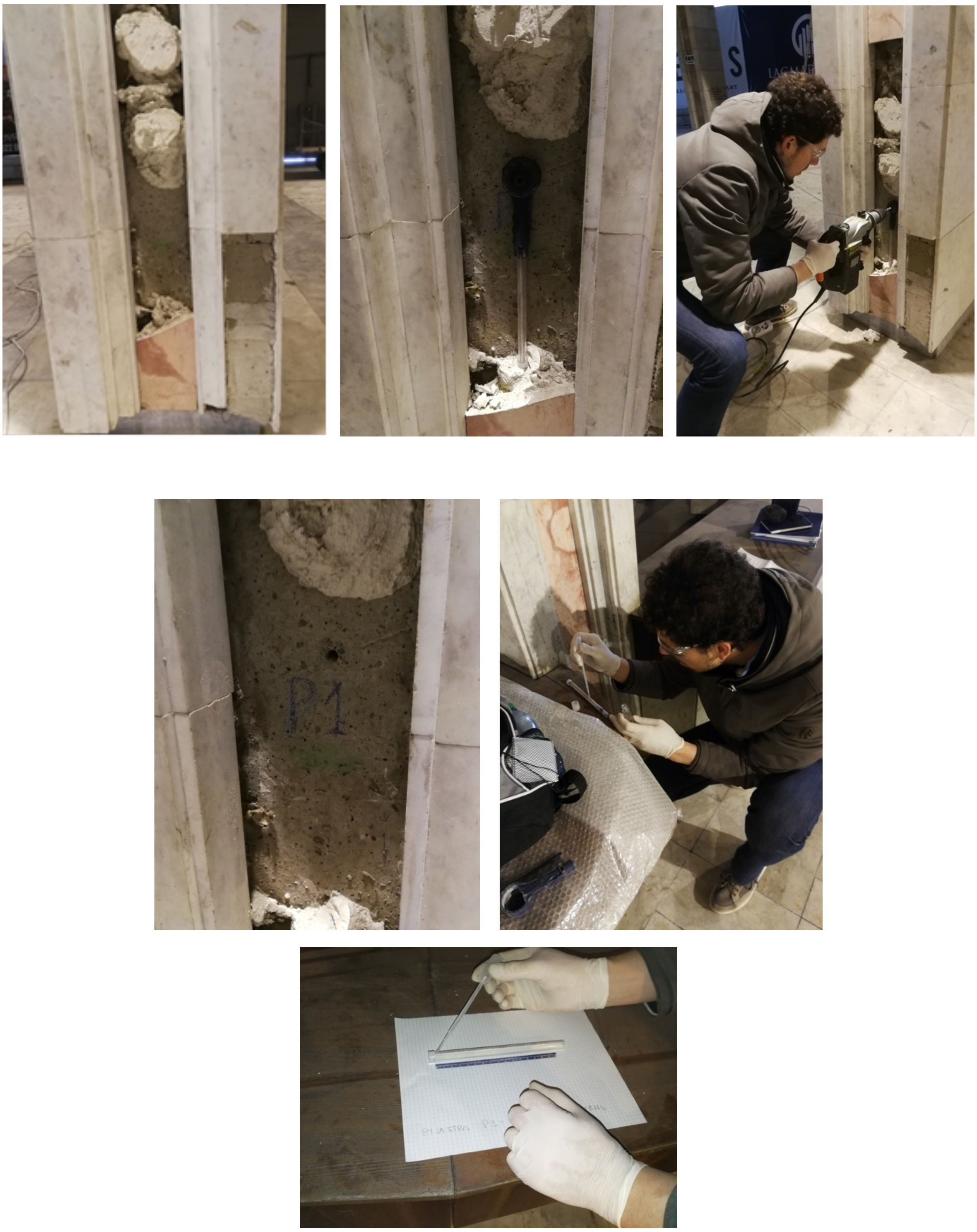
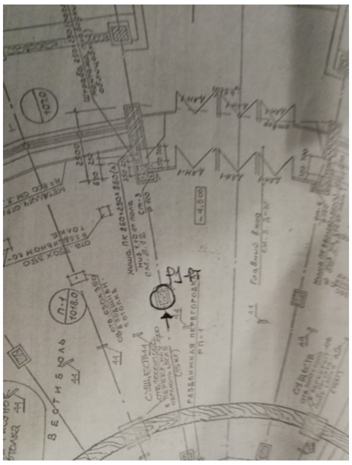
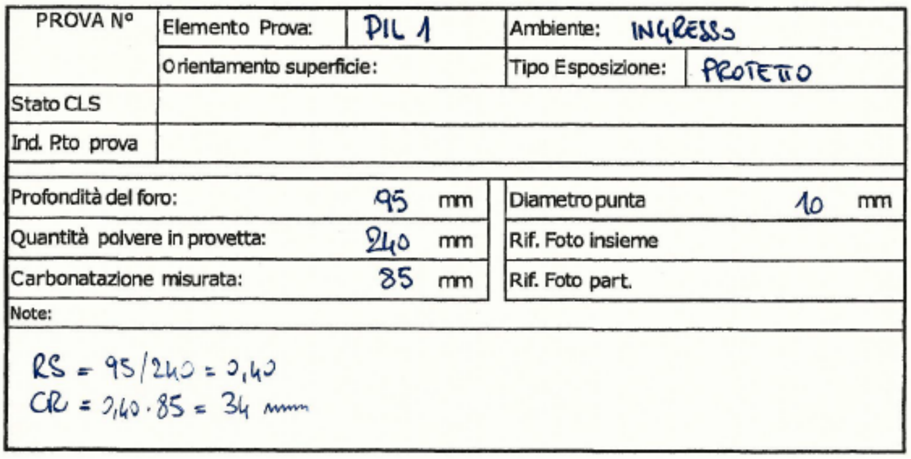


Figure 36: phenolphthalein test procedure

TEST1: P1- GROUND FLOOR

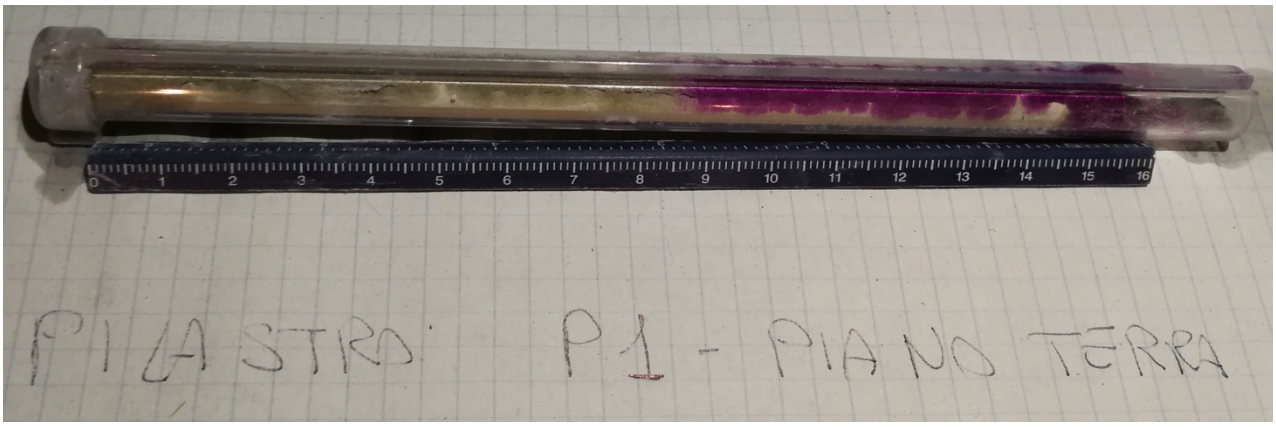




PROVA N°	Elemento Prova:	PIL 1	Ambiente:	INGRESSO
	Orientamento superficie:		Tipo Esposizione:	PROTETTO
Stato CLS				
Ind. P.to prova				
Profondità del foro:	95 mm		Diametro punta	10 mm
Quantità polvere in provetta:	240 mm		Rif. Foto insieme	
Carbonatazione misurata:	85 mm		Rif. Foto part.	

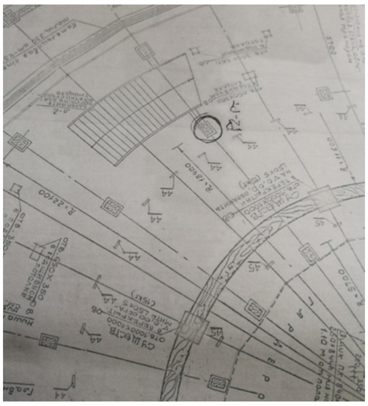
Note:

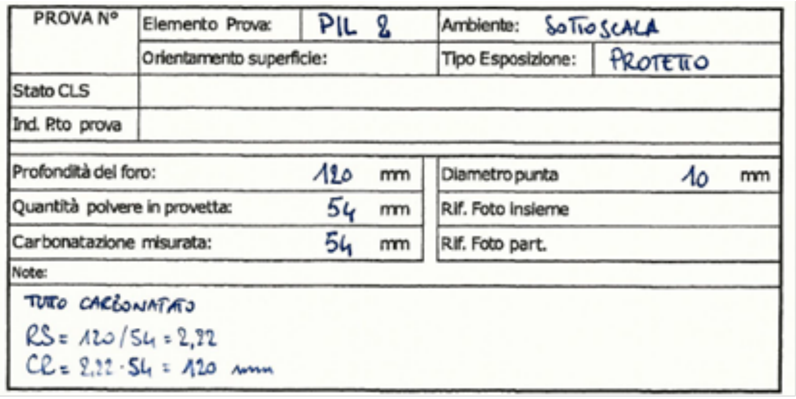
RS = 95/240 = 0,40
CR = 0,40 · 85 = 34 mm


0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
PILASTRO P1 - PIANO TERRA

As can be seen from the above picture, about 34mm of the concrete more external cover are carbonated.

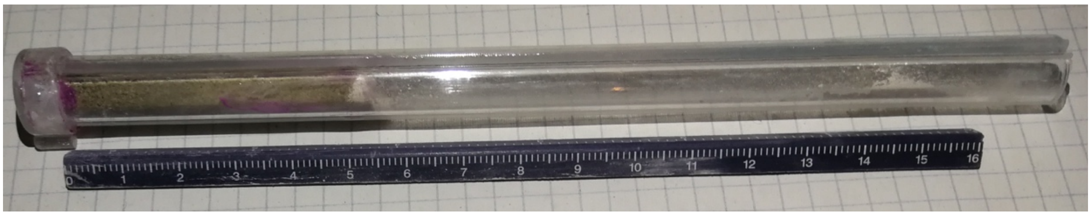
TEST2: P2- GROUND FLOOR

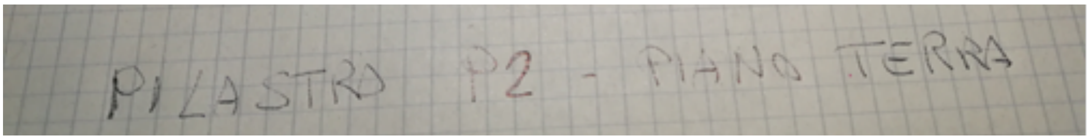




PROVA N°	Elemento Prova:	PIL 2	Ambiente:	SOTTOSCALA
	Orientamento superficie:		Tipo Esposizione:	PROTETTO
Stato CLS				
Ind. Pto prova				
Profondità del foro:	120 mm		Diametro punta	10 mm
Quantità polvere in provetta:	54 mm		Rif. Foto insieme	
Carbonatazione misurata:	54 mm		Rif. Foto part.	
Note:				

TUTTO CARBONATATO
RS = 120/54 = 2,22
CR = 2,22 · 54 = 120 mm

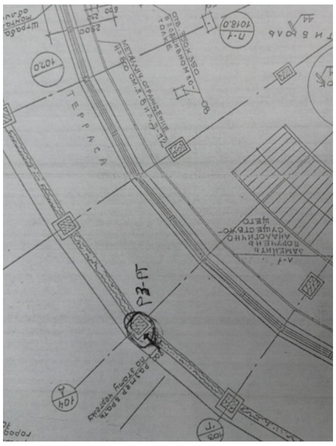


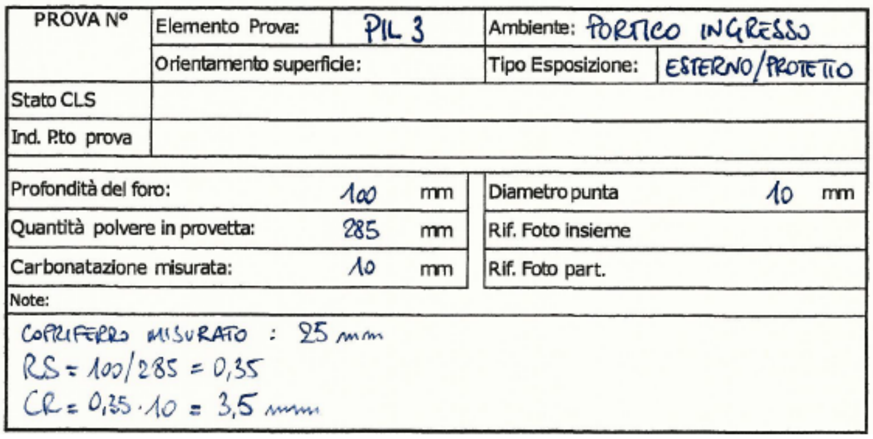


PILASTRO P2 - PIANO TERRA

As can be seen from the above picture, about 54mm of the concrete more external cover are carbonated.

TEST2: P3- GROUND FLOOR – external





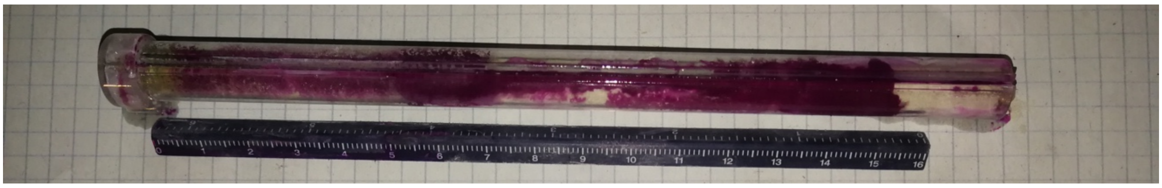
PROVA N°	Elemento Prova:	PIL 3	Ambiente:	PORTICO INGRESSO
	Orientamento superficie:		Tipo Esposizione:	ESTERNO/PROTETTO
Stato CLS				
Ind. P.to prova				
Profondità del foro:	100	mm	Diametro punta	10 mm
Quantità polvere in provetta:	285	mm	Rif. Foto insieme	
Carbonatazione misurata:	10	mm	Rif. Foto part.	

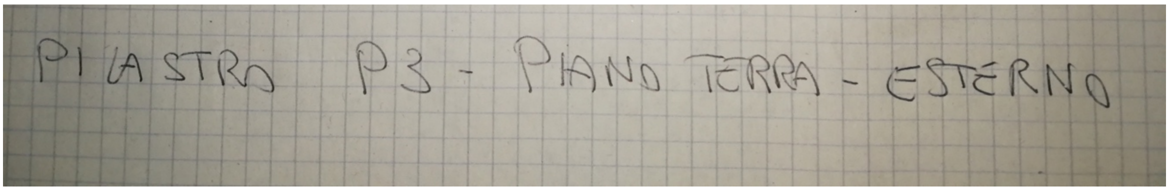
Note:

COPRIFERRO MISURATO : 25 mm

RS = 100/285 = 0,35

CR = 0,35 · 10 = 3,5 mm





PILASTRO P3 - PIANO TERRA - ESTERNO

As can be seen from the above picture, about 10mm of the concrete more external cover are carbonated.

Endoscopies

Hereafter some pictures of the stairs taken from endoscopies are reported.

As can be seen, a pre-fabricated structure is adopted for steps, supported by steel profiles, partially corroded.

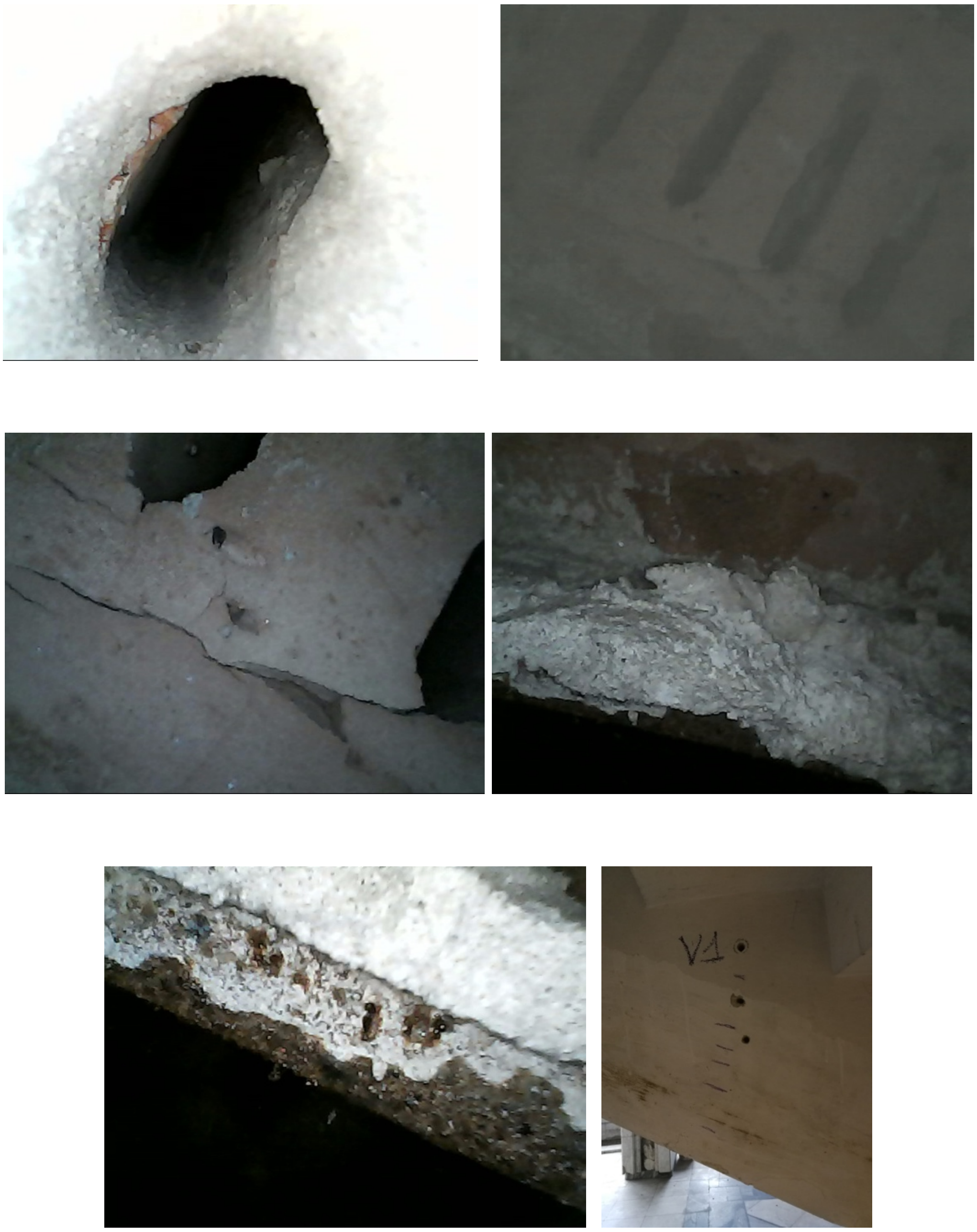


Figure 37: endoscopies of the stairs

Conservation/degradation of the structures

During the survey conducted by the experts in February 2019, a global overview of the conservation conditions of the Circus was performed.

First of all, it should be remarked the severe level of degradation of the marble panels that encase the main steel external trusses, going from the ground level to the top.

Some panels, whose thickness is about 1,5 cm, are already detached from their supports, while some others are affected by evident cracks and are near to collapse.

An immediate consolidation intervention is needed, for safety, as already mentioned in the first paragraph of the present report.

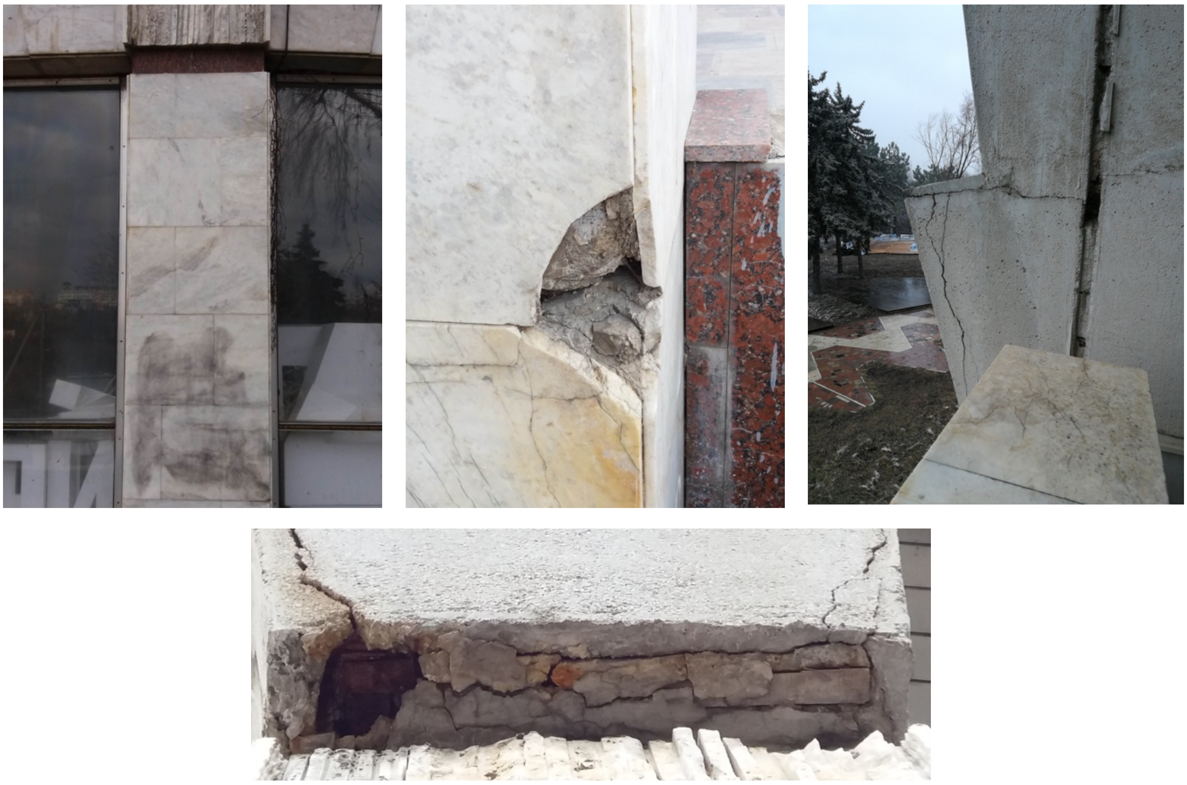


Figure 38: damages of the marble panels

The main steel external structure appears subjected to a diffused corrosion process, especially for those elements not protected by marble panels. A deeper investigation is needed, as describe in the following paragraph.

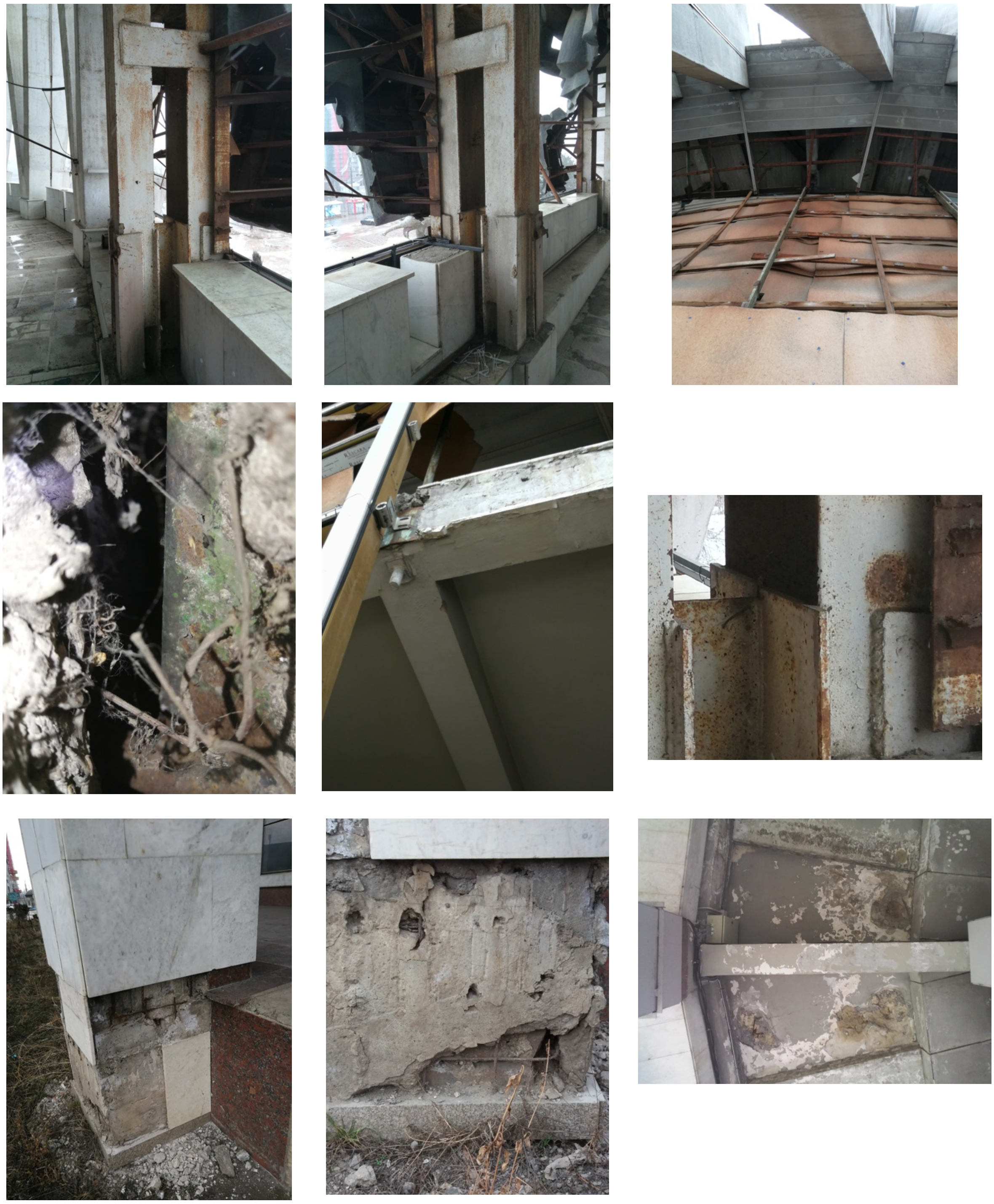


Figure 39: Corrosion of the principal external steel and r.c. structural elements

Also part of the inside steel elements appears to be partially corroded.

AC

S1

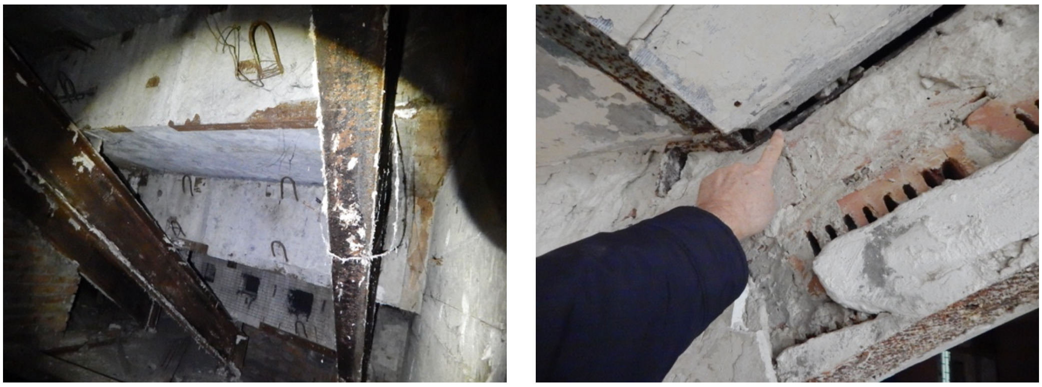


Figure 40: corrosion of inside steel elements

It was difficult to analyze the level of conservation of internal r.c. beams, columns and slabs due to the presence of false ceiling and coating. Anyway, for the observed elements, no evident structural cracks were detected, meaning that macroscopic structural settlements are not ongoing.

Small cracks were detected on the masonry wall that divides the inferior steps of the circus and the corridor. On that cracks a simple but precise monitoring system was applied during the survey, as reported in the figure below.

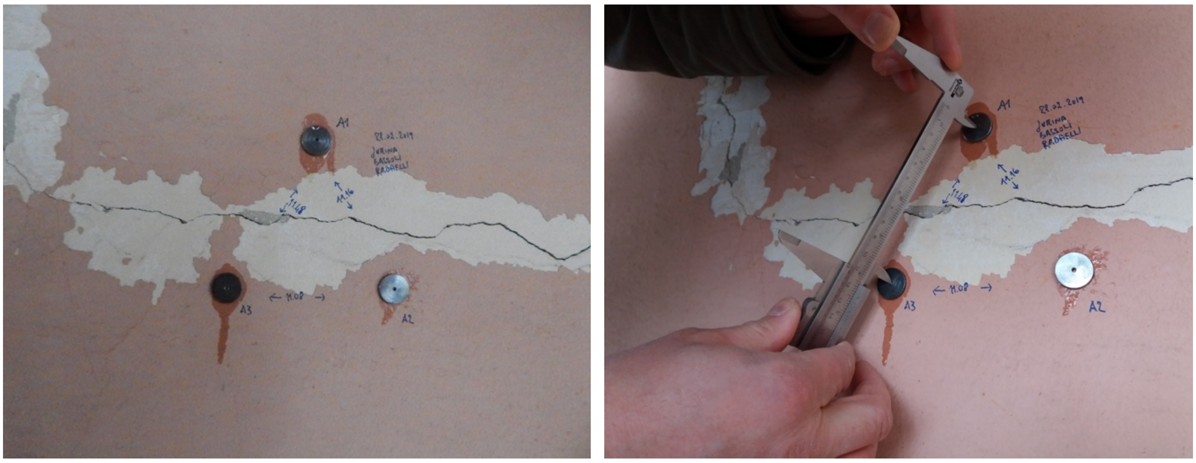
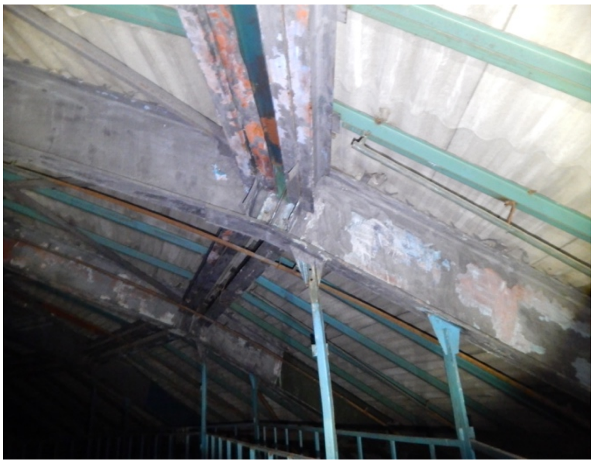


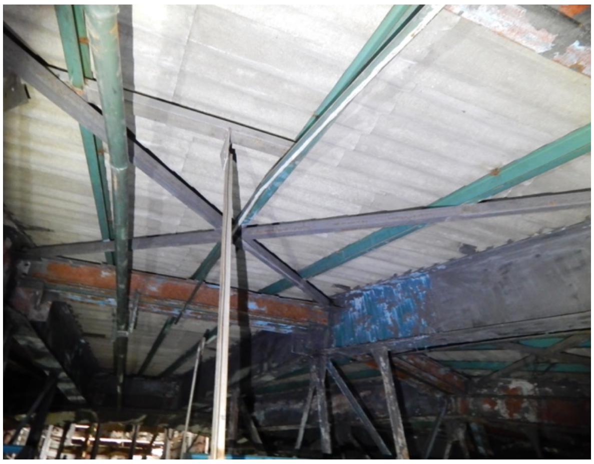
Figure 41: crack monitoring system applied on the wall of the first floor

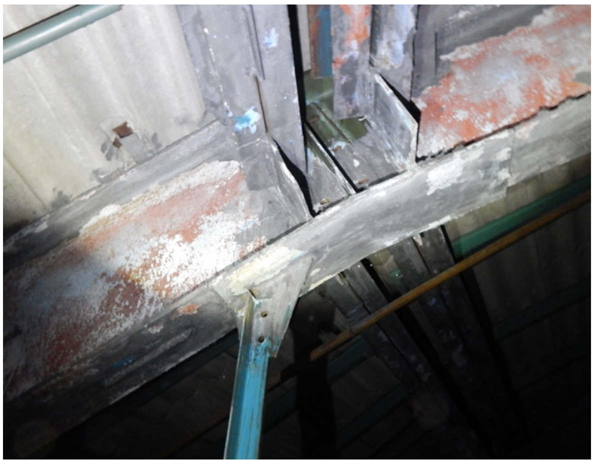
Concerning the roof, it was observed a not recent attempt of protection on some of the principal steel beams, by applying a thin coating. The remaining elements are not protected, neither to prevent possible corrosion phenomena, nor for fire prevention.

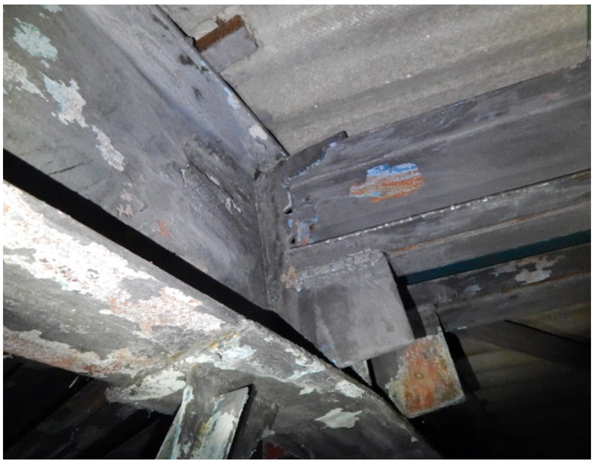
It should be highlighted the non uniform types of connections between steel beams.

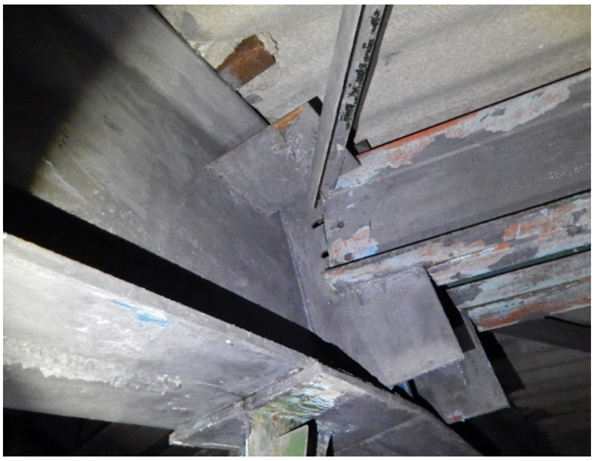
Some of them are bolted, while some others are welded, even if some holes for bolts are present.

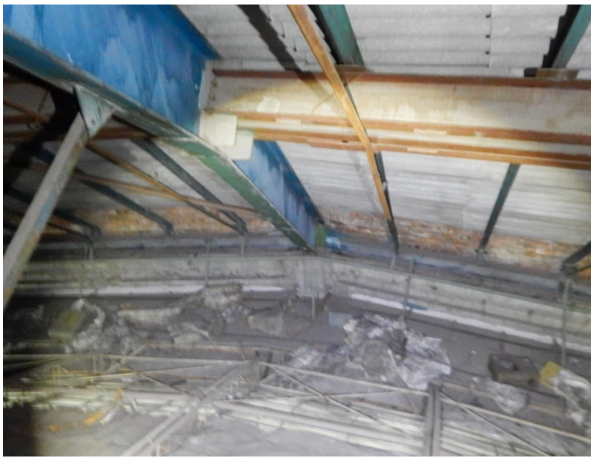












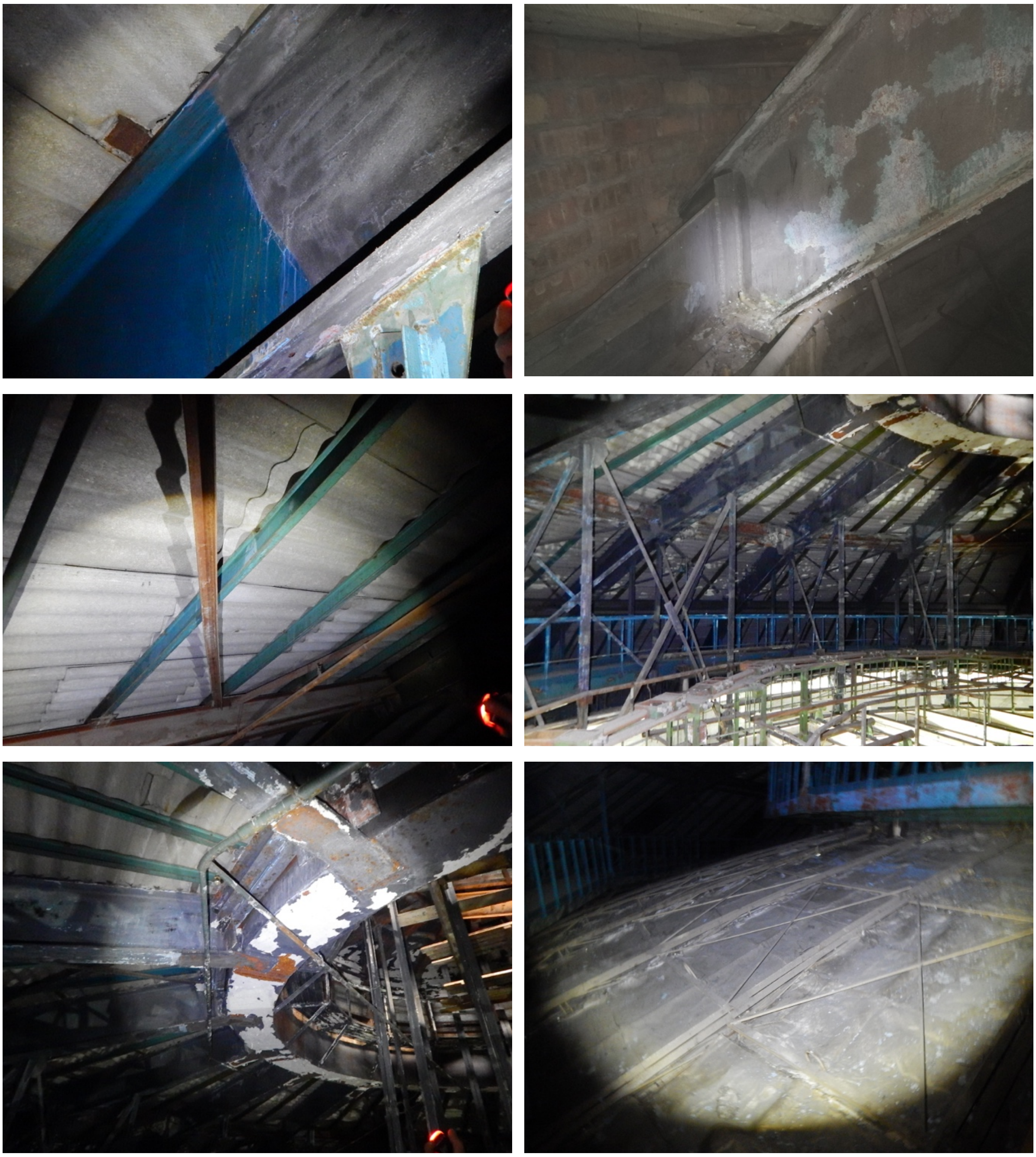


Figure 42: Steel structure of the roof

The finishing package of the roof is composed by a fibercement corrugated board, a layer of rock wool, a single wooden board and a galvanized steel cover.

The internal layers appear in good condition of conservation, while the galvanized steel cover presents local corrosion phenomena.

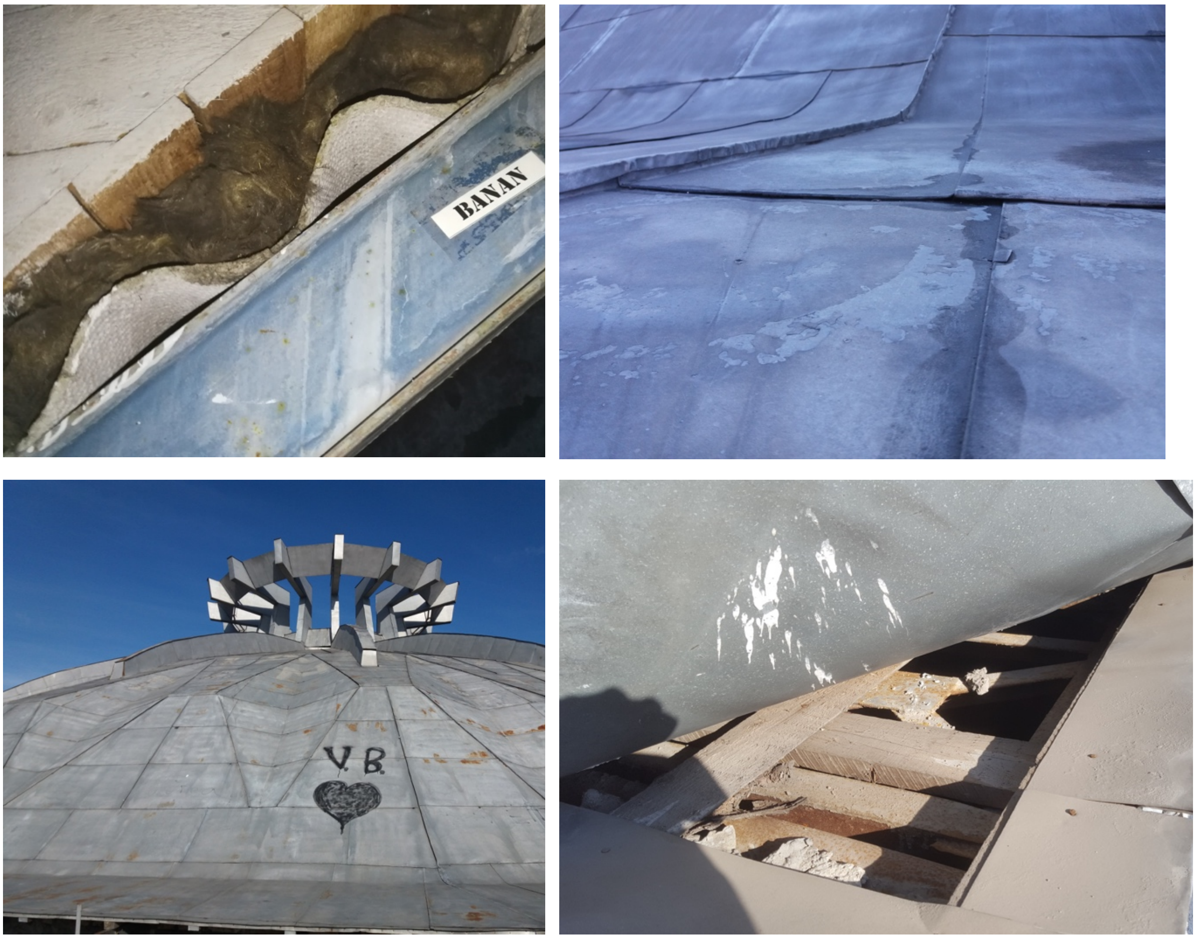


Figure 43: cover system

Conservation/degradation of finishing

The finishing (floor, decorations, sculptures) are well conserved. Only few restoration interventions are needed, mainly a superficial cleaning and local integrations. The high quality of the finishing must be highlighted.

The only vulnerable element consists in the false ceiling. A thick layer of plaster is supported by a steel net, severely corroded.

Here after some pictures of the precious finishing, such as paintings, sculptures and mosaic.

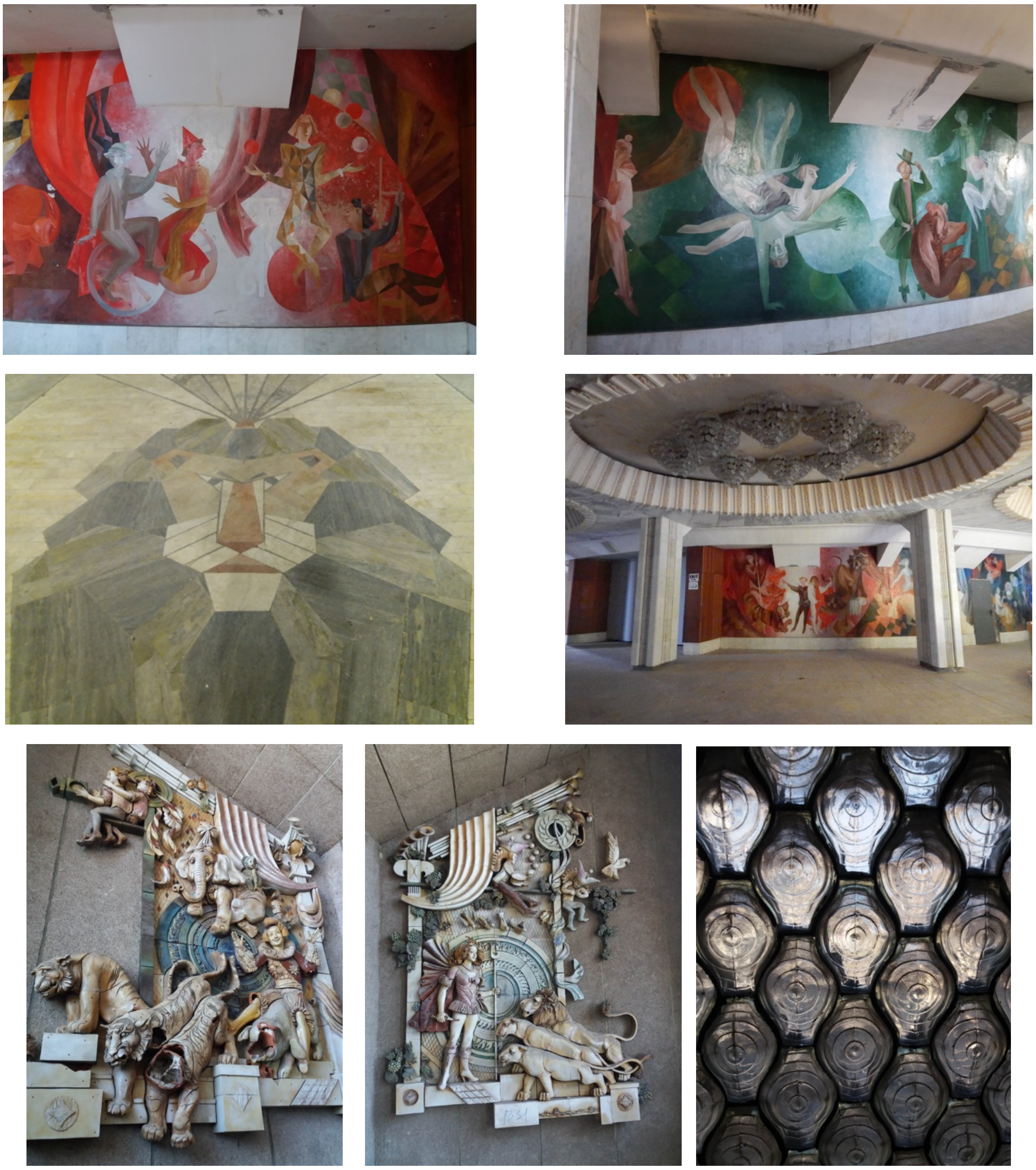


Figure 44: Paintings, sculptures and decoration of the circus

Conservation/degradation of technical installations

The heating system, originally connected to the municipal thermal power plant, appears completely out of order. The heat exchanger is no more present, while existing ventilation shafts could be possibly used in future for any new heating device.

The electrical system, even if partially working, is not respectful of the actual safety standards, imposed by Regulations.

Pipes for the fire system were observed in the roof, but no further information are available about their functioning.

A complete renewal of the system, according to the current standards and green – energy criteria, is required and described in the following paragraph.

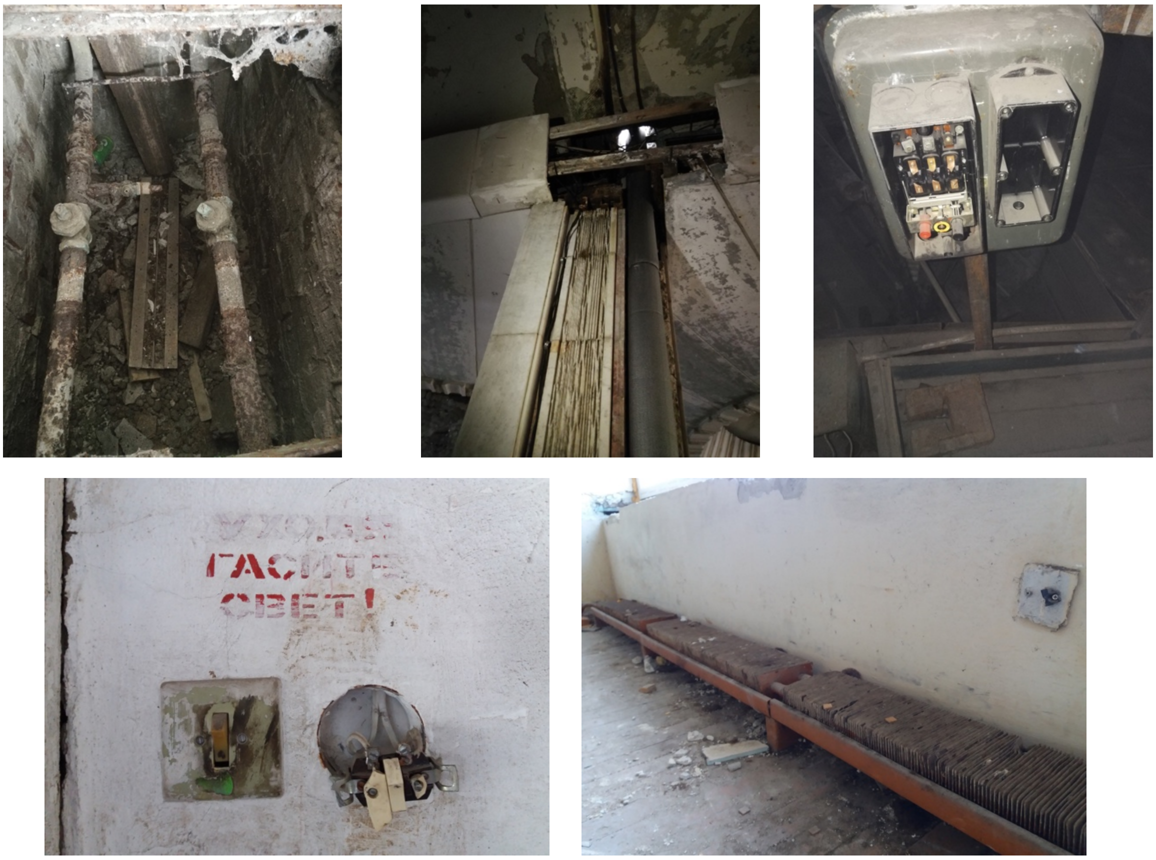


Figure 45: Technical installations

GUIDELINES FOR INTERVENTION

Understanding the significance of the Circus

Understanding the significance of the Circus means to understand its real importance in the scenery of the monumental Moldovan buildings.

As already mentioned in chapter 4, Chisinau Circus represents a particular example of Sovietic architecture, for design choices not strictly aligned with the principles provided at that time by Moscow.

Started as monolithic, for economic reason the circus was built with steel trusses and prefabricated elements.

Thus, all the adopted structural solutions constitute a uniqueness that deserve to be deepened and valued.

It is the case, for example, of the "V" shape perimetral elements, realized by a steel frame structure and covered by a layer of concrete and by a finishing with marble tiles.

Further, it is the case of the massive dome, made by steel curved beams.

From a structural point of view, even the confinement steel rings at the level of the first floor and at the level of the supports of the roof deserve to be analyze in deep, not only for static vertical loads, but also for seismic horizontal loads.

Finally, the precious decorations of the floor, of the chandelier, of the sculptures and of the paintings on the walls represent another effective reason for understanding the significance of the Circus.

The assessment of the significance of the Chisinau Circus needs to be fulfilled by the following complementary activities:

1. The geometrical and mechanical characterization of the building, by means of a deep diagnostic campaign.
2. The assessment of the structural decay of the building, discovering the vulnerabilities with respect to the live load (static and seismic) required by the actual Standards.
3. The assessment of those finishing (mainly floors, outside and inside sculptures) that are of high heritage value and must be conserved.
4. Supporting original drawings and photographs.

The above has to be prepared within the Masterplan but it can be further detailed in the Technical Expertise. This implies close cooperation between the Team charged with the preparation of the Masterplan and the Team charged with the elaboration of the Technical Expertise for the Circus.

Preliminary documentation to be prepared

Historic report

As already reported in chapter 5.1 of the present report, historic documentation concerning the original project has been already collected.

Anyway, in order to have an adequate knowledge of the structure, it is necessary to collect some other documents:

- Report on structural calculations;
- Work log;
- Transport notes of the materials;
- Mechanical tests performed on concrete and steel specimens during the construction works;

- Final test.

Geometrical survey

The current state of knowledge of the Circus is based only on the original drawings, conserved at the Agenția Proprietatii Publice a Republicii Moldova – Institutul National Cercetari si Proiectari URBANPROIECT.

In order to get a complete geometrical information to perform the structural analysis, an accurate survey is needed.

Due to the complexity of the building, that presents many structural parts hidden by false ceilings and finishing while some other portions are difficult to reach, it is suggested to perform a geometrical survey by means of a laser scanner 3D and drone, but also in a "traditional way", based on visual inspection.

The laser scanner will be able to provide the global geometry of the building, but dimensions of steel and concrete elements, nodes, thickness of slabs, diameter of bolts, thickness of framing structures and many other details should be directly measured.

Even the area in the nearby of the Circus requires a topographic survey.

During the survey all the constitutive materials (structural and non-structural) and the decay need to be mapped. Results, supported by an adequate photographic report, must be reported in plan view and sections.

In the following paragraph 7.3 detailed information for the geometrical survey is provided.

Diagnostic investigation

In order to obtain a deep knowledge of the mechanical properties of the constitutive materials it is necessary to perform a diagnostic campaign, whose results will be used as input data in the FE Model for the static and dynamic verifications.

Due to the importance of the building, all the test must follow the European Standards, both regarding the requirement of personnel in charge to perform the tests and the modality of investigation.

Hereafter the main Standards are listed:

- Qualification for personnel in charge to perform on site non-destructive test: EN 9712:2012
- Sclerometric test: EN 12504-2:2012
- Ultrasonic test: EN 12504-4:2005
- Sample and compression test on concrete: EN 12504-1:2009
- Pull-out test: EN 12504-3:2005
- Windsor test: ASTM C 803
- Visual inspection: EN 13018:2004
- Non destructive test – General terms: EN 1330-1:2000
- Magnetoscopic test: EN 1330-7:2005
- Geotechnical test: EN 1997-2:2007 - 2

Details of the diagnostic campaign are contained in the following paragraph.

It’s worth to anticipate here the necessity to have information about the geotechnical aspects of the site, about foundations, mechanical residual properties of concrete and steel, about corrosion of steel elements, and also about the global dynamic behaviour of the structure.

For the reason, several kinds of investigation are required.

CONSERVATION AND REHABILITATION PROGRAMME

Priority of intervention

Based on the survey conducted by the team of experts in February 2019 and on the information up to now collected, it is possible to individuate some priorities in the conservation and rehabilitation program of the Circus.

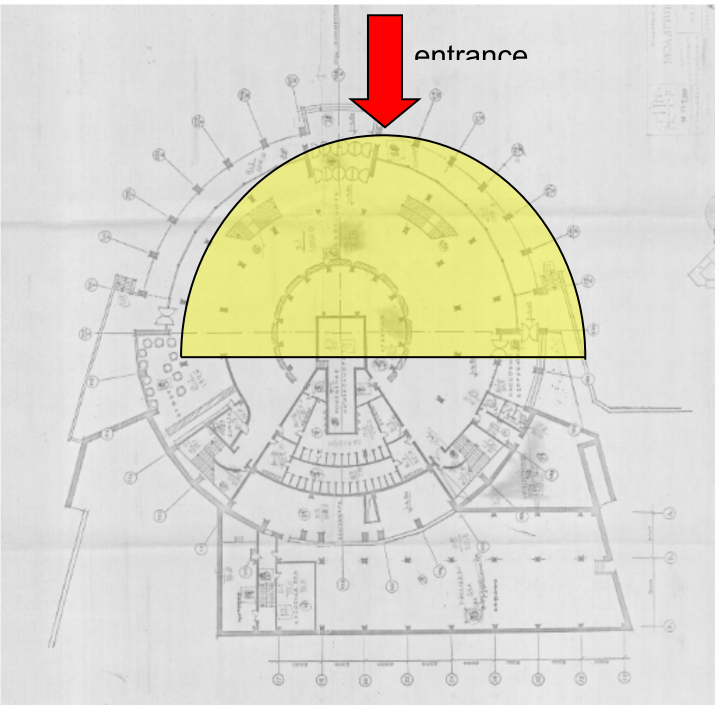
First of all, as described in paragraph 1.1 and 1.2, it is necessary to do, as soon as possible, some urgent securing interventions concerning the marble tiles on the facades and the broken windows.

These interventions are need on one side for safety reason, on the other side to preserve precious sculpture and finishing.

A second phase can allow the partial opening of the Circus, to get people appreciating the building itself and to have some short exhibition in the foyer (see following picture).

Structural interventions are priority on steel and reinforced concrete structures. In particular:

- waterproofing reparations of the roof to avoid any further water infiltration;
- passivation and protection from corrosion of all the exposed steel elements of the V-shape trusses and outside steel slabs;
- passivation and protection from corrosion of all r.c. exposed bars, including the reconstruction of the cover with two-component, anti-corrosion cementitious mortar for steel reinforcement rods;
- removing of the false ceiling and countertop, allowing the passivation and protection of the steel elements of the ground floor, especially of the foyer;
- passivation and protection of the steel elements of the ground floor / foyer;
- replacing of the countertop, considering the possibility to insert new pipes for the heating and ventilation system of the circus (not to be done in this phase);
- integration of missing doors and windows, similar to the one adopted in recent years;
- Integration of safety door and safety systems for the foyer;
- new electrical system and wiring for the foyer;
- cleaning and conservative intervention at the main entrance: decorated floor, finishing, chandeliers;
- realization of a safe path for visitors to enter in the arena.


entrance

Implementation phases

FEASIBILTY STUDY

The feasibility study represents a relevant phase in the design process of the rehabilitation of Chisinau Circus, due to the complexity of the building.

The study therefore should take into consideration several objectives, focused at two different scale, i.e. at the scale of the building and at a macro-scale, involving the urban contest.

At the scale of the building, it is necessary to:

1. collect all the documentation listed in paragraph 6.2.1 of the present report;
2. define a general view of the design project, considering the economical aspects of consolidation and renovation intervention;
3. individuate the priorities that allow the opening of a portion of the Circus, at least the foyer, as described in paragraph 7.1 of the present report, both from a technical and economical point of view, including an analysis of the economical sustainability of the intervention;
4. provide all the information useful for the implementation of the Expertise.

At macro-scale, the feasibility study should point out:

1. the cultural enhancement of the Circus for the community of Chisinau;
2. the environmental, social and economic sustainability of the rehabilitation process, both in medium and long period;
3. the participation in development, with the aim of creating a business and impact employment;
4. the recovery of functions compatible with the building and its setting;
5. the implementation of eco-sustainable forms of transport that connect the city centre with the Circus in occasion of significant events.

The Government Decision 1029/2013 understands the Feasibility study as a document based essentially on legal and socio- economic data, aiming at verifying the respondence of the project proposal to socio -economic needs, the technical, economic and institutional capacity to implement the proposal and to assess the impacts in terms of benefit- costs analysis.

Therefore, this type of feasibility study is not designed to address adequately the specificity of what is needed in developing a project on heritage asset. On the other hand, the GD 1029 regulates in detail the content of the Feasibility Study and therefore needs to be taken into account:

Table of contents for the feasibility study
1. Summary
2. Analysis of the existing context
2.1 Overview of the social and economic context
2.2 Government policy for the sector / subsector
2.3 Roles and responsibilities in the sector / sub-sector
6.2 Summary of main findings from social impact assessment
6.3 Requirements for environmental permits
7. Implementation and operational arrangements
7.1 Capacities of the entities responsible for implementation and operation
7.2 The Framework Plan and a timetable for the implementation of the project

2.4 Summary of results of previous studies
3. Market assessment and demand analysis
3.1 Needs analysis and identification of target
users
3.2 Analysis of options
3.3 Defining project outcomes
3.4 Demand forecast
4. Analysis of spatial planning problems
4.1 Reviewing land-use issues
4.2 Compliance with spatial plans
4.3 Purchase of land
5. Technical studies and project costs
5.1 Polls (surveys) on the ground
5.2 Environmental conditions
5.3 Preliminary technical design
5.4 Maintenance interventions
5.5 Input parameters for construction and
operation
5.6 Estimates of capital and operating costs
over the life of the project
6. Environmental and social impacts
6.1 Summary of the main findings from the
environmental impact assessment
7.3 Project Management Arrangements
7.4 Organizational arrangements for the
operation of the project
8. Financial and Tax Analysis
8.1 Methods and assumptions
8.2 Financial analysis results
8.3 Conclusions on financial viability and
financial performance
8.4 Impact on the budget
9. Economic Analysis
Preliminary brief for the conservation and enhancement of Bender fortress (Thighina)
61
9.1 Methods and assumptions
9.2 The results of the economic analysis
9.3 Conclusions on economic feasibility
10. Risk analysis and management
10.1 The main risk factors and their impact
10.2 Mitigation measures
10.3 Risk Management Plan
11. Final conclusions on the feasibility of the
project

Task

The Feasibility study, in coherence with the above mentioned documents will be organised according the structure indicated by the HG n. 1029/ 2013 as presented above, but must address specifically the following:

- recognition, identification and mapping of the different part of the building, from structural, architectural and decorative point of view;
- assessment of state of conservation of the building;
- understanding and explanation of the cultural significance;
- identification of threats to its condition and process of decay;

Furthermore, the Feasibility study should:

- clearly define the project objectives;
- principles for environmental sustainability;
- financial and economic feasibility of intervention and maintenance;

- legal and regulatory guidance;
- a plan for community consultation

Deliverables

The Feasibility study report shall include the following:

- detailed report with attached photographic / graphic documentation;
- analysis of the overall context of the territory nearby Chisinau Circus;
- the assessment of the structural and architectural morphology, based on historic research;
- the assessment of the state of conservation and of the vulnerability of the building;
- preliminary identification of possible uses of buildings, compatible with its intrinsic characteristics;
- analysis of possible opportunities in relation to regulatory, authorization, planning constraints and any operational, financial and commercial topic regarding its possible use;
- the expected results on the short, medium and long term, the set of actions and works to be carried out, the priority order of the actions, the services to be provided and activities that are however relevant for local development or for the redevelopment of the nearby;
- the estimate of the overall implementation costs;
- the estimate of conservation-maintenance and long-term monitoring of the buildings;
- preliminary elements for a business plan to support the implementation of the programme;
- identification of priorities and strategies for the partial opening of the Circus.

Professional qualifications and general requirements

The Feasibility Study requires the following competences:

- **Architect**, with experience in the field of conservation of existing buildings.

The competence of the professional must be demonstrated through:

- projects done in the last 10 years, regarding public or private buildings, with characteristics of cultural heritage.
- 2 projects done in the last 10 years, regarding public or private buildings with characteristic of cultural heritage. The 2 projects have to be illustrated through a presentation in format A3 (maximum 5 sheets for each project, including text , figure and tables).
- Master Degree (or equivalent) in architecture;
- Possession of professional licence (e.g. registered architect) from at least 10 year:
- Good command of English language.

- **Structural Engineer**, with experience in the field of static and dynamic calculation.

The competence of the professional must be demonstrated through:

- projects done in the last 10 years, regarding calculation of complex structures. The professional must demonstrate knowledge and experience in FE modelling.
- 2 projects done in the last 10 years, regarding calculation of complex structures.

The 2 projects have to be illustrated through a presentation in format A3 (maximum 5 sheets for each project, including text , figure and tables).

- Master Degree (or equivalent) in civil engineer;
- Possession of professional licence (e.g. registered engineer) from at least 10 year:
- Good command of English language.

- **Economist**
  - Master Degree (or equivalent) in economics applied to cultural heritage;
  - proven experience in developing business/ sustainability plans for masterplans or management plans for cultural/ natural heritage sites (e.g. at least one plan elaborated over the last 5 years);
  - Good command of English language.

TECHNICAL EXPERTISE

According to the Government Decision (HG) n. 936 of 16/08/2006 technical expertise is a complex of measures for determining and evaluating the real characteristics of the building in order to ensure the functionality and the possibility of further use and it implies studies, researches, tests and assessments of the existing situation, calculations and verifications for ensuring the minimum level of quality stipulated in the Law on quality in construction.

It is mandatory for all types of constructions, that is to say, it is not specifically conceived for heritage buildings, as a preliminary step before consolidation, modernization, capital repairs, rehabilitation, transformation, enlargement interventions can take place. It will be carried out preliminarily to the drafting of the project sketch and according to the indications of the purposes and the technical features identified by the standard.

The contents of the Technical Expertise are defined by the art. 26 of the HG n. 936 /2006 and concern:

a) the documents on the basis of which the technical experience was carried out, the purpose of the experience, its necessity, etc.;

b) architectural, functional and structural features of the building; the beneficiary, the designer, the entrepreneur, the construction phase;

c) scheme and constructive solutions, geotechnical conditions of the terrain, urban situation;

d) technical condition of the constructive elements and of the construction as a whole, the non-conformities found, their causes and consequences, the estimation of the degradations;

e) conclusions and recommendations for strengthening, validating and optimizing them from a technical, economic, technological and functional point of view. In particular, it is important to pay attention and to make an accurate description of the risk assessment and of the mitigation measures that must be provided in relation to the cultural values potentially lost due to the different design solutions.

f) sketches, details of execution and other graphic materials.

Task

The following paragraph refers to the activities to be done in the technical expertise, that mainly concerns with relief, diagnostic campaign and design of priorities and intervention for a partial opening of the Circus.

Geometrical survey

As a preliminary activity, the geometrical survey need to be performed according to the following:

1. Examine of the original structural project drawings and check the geometrical correspondence with the realized building. Useful information of the construction phases can be also collected through historic photos and cards.
2. Perform a 3D laser scan of the inside and outside of the Circus, including the small circus and offices.

3. For the Circus, from the 3D laser scan cloud, a minimum of 8 vertical cross sections and 10 horizontal cross sections need to be obtained.
4. Photo-straightening of the façades need to be collected, to check either geometry and material degradations.
5. By using a drone, an accurate survey of the cover can be performed to check either geometry and material degradations.
6. “Traditional” geometrical relief for those rooms not accessible by the laser scan and accurate relief of all the structural elements and nodes.
7. Use a multiple image sets of SAR interferometric data acquired by past and current satellite platforms, for monitoring ground displacement in the nearby of the Circus. Data should be collected for at least 10 years.
8. Relief of the crack pattern of structural and non-structural elements, identifying at least 3 different crack opening (less than 1 mm, between 1mm and 5 mm, more than 5mm).
9. Inspection of foundations, realizing a minimum of 4 excavations, 2 closes to columns and 2 closes to perimeter walls. Width and depth of foundations have to be recorded and checked with the original design drawings.
10. Topographic survey, linked to the National network, of the square in front of the main entrance of the Circus and of the nearby.

Diagnostic investigations

The following minimum investigations are necessary for an adequate knowledge of the Circus:

Diagnosis on reinforced concrete consist in:

a) at least 9 cylindrical samples (3 at ground floor, 3 at first floor, 3 at second floor) need to be extracted from r.c. columns;
b) at least 9 cylindrical samples (3 at ground floor, 3 at first floor, 3 at second floor) need to be extracted from r.c. beams;
c) at least 6 cylindrical samples need to be extracted from r.c. steps of the main arena;
d) at least 30 SonReb (Sonic + Rebound) tests need to be performed on r.c. elements.

Diagnosis on steel rebars:

a) at least 6 samples of steel rebars have to be extracted from r.c. elements and tested in authorized laboratory, to evaluate the yielding stress and ultimate strength of the steel.

Diagnosis on steel elements:

a) accurate inspection of the nodes between steel elements;
b) in situ tests on steel elements through Vickers durometer, to be performed on external steel trusses (at least on 10 points at different levels), on beams (at least on 3 beams for each level) and on roof beam (at least on 10 points on primary and at least 20 points on secondary beams);
c) measurement of the thickness reduction on the same point where Vickers durometer is applied.
d) visual inspection and in situ tests on welds, through penetrating liquids or magnetoscopic method, to be performed at least on 20 welds.

Geological and geotechnical diagnosis consists in:

a) geological report, based on at least 3 sample of soil, extract up to 20m depth; during the extraction of samples, Standard Cone Penetration Test (SCPT) need to be performed, according to the actual standard;
b) evaluation of the ground water level through at least 3 piezometer tests;

c) seismic analysis through at least 2 MASW (Multichannel Analysis of Surface Waves), a non-invasive investigation technique that allows the definition of the velocity profile of vertical shear waves Vs, based on the measurement of surface waves made at different sensors placed on the soil surface. It is suggested to perform a MASW test on opposite side of the Circus;
d) seismic station passive seismic analysis through at least 3 HVSR (Horizontal to Vertical Spectral Ratio).

Load test consists in:
a) at least 2 load tests need to be performed on the steps of the main arena;
b) at least 2 load tests on the slabs
c) at least 1 load test on the main stair.

For the arena, 4 LVDT (Linear Variable Displacement Transducer) have to be positioned under each loaded step and 2+2 LVDT need to be positioned under the 2 r.c. beams that support the step.

For the slabs and stair, at least 9 LVDT need to be adopted, in order to evaluate the continuity of the slab and the collaboration between steps.

Two cycles of load have to be performed.

Dynamic characterization of the structure with measurement of the own frequencies, for stresses induced by microtremors. Dynamic environmental test has to be performed with tri-axial accelerometers, appropriately distributed on the structure (roof and main arena).

Data processing and analysis for determining the modal parameters of the modes of vibrating can be worked out with OMA method (Operational Model Analysis).

Finite Element numerical Modeling

The structure model must be three-dimensional and adequately representative of the actual spatial mass distributions, stiffness and resistance, with particular attention to the situations in which the horizontal seismic action can produce vertical inertia forces (e.g. beams of long span, long cantilever, etc.).

A dissipative behavior model must be adopted. It must explicitly take into account the dissipative capacity. The constitutive model for the non-linearity of material must be justified, also in relation to the correct representation of the energy dissipated in hysteresis cycles.

Geometric non-linearities, if significant, can be considered.

In considering the stiffness of the structural elements, the cracking must be taken into account. In case no accurate information were available, flexural and shear stiffness can be reduced up to 50% of the rigidity of the non-cracked straight elements, taking into account the considered limit state and the influence of permanent axial stress.

Except for specific evaluations demonstrating that the present openings do not significantly reduce the stiffness, slabs can be considered infinitely rigid in their plane if a reinforced concrete slab, at least 40 mm thick, is present (50 mm thick in mixed structure with reinforced concrete slab), properly connected.

The actions resulting from seismic motion can be modeled either through equivalent static forces or response spectra, either through temporally selected ground motion stories, all appropriately selected.

The seismic demand can be evaluated considering the effects of both inertial and soil-structure interaction

kinematic, as well as defining the seismic input of the project through local seismic response analysis.

Relevant procedures methods and models of proven validity must be used and FEM must be calibrated, according to the results gained by the diagnosis, especially by the dynamic in situ tests.

Both linear and non-linear analysis can be performed; in any case, Serviceability Limit State (SLS) and Ultimate Limit State (ULS) must be taken into account.

Static and dynamic verifications must be worked out on the structures such as column, beams, slabs and roof, highlighting the residual capacity of the element (i.e. the ratio between supply and demand).

Globally, the numerical analysis must provide the residual return period of the structure.

Deliverables

The Technical Expertise shall include the following:

- detailed report with attached photographic / graphic documentation of the relief;
- detailed report with attached photographic / graphic documentation of the diagnostic campaign;
- report containing a commented synthesis of the results from the diagnostic campaign;
- calculation report highlighting the structural vulnerability of the Circus;
- graphical drawings in plan and in elevation (scale 1: 100 or 1:50), which identify:
    - geometrical structural and architectural relief;
    - different materials and construction techniques;
    - superficial and structural degradations;
    - crack pattern;
    - structural vulnerabilities;
- conclusions and recommendations for the improvement of the structural conditions and the mitigation of the degradation phenomena of the materials of the building elements;
- preliminary requirements for the consolidation interventions in order to open at least the foyer of the circus (definition of minimum requirements).

Professional qualifications and general requirements

The Technical Expertise requires the following competences:

- **Architect**, with experience in the field of conservation of existing buildings.

The competence of the professional must be demonstrated through:

- projects done in the last 10 years, regarding public or private buildings, with characteristics of cultural heritage.

- 2 projects done in the last 10 years, regarding public or private buildings with characteristic of cultural heritage. The 2 projects have to be illustrated through a presentation in format A3 (maximum 5 sheets for each project, including text , figure and tables).
- Master Degree (or equivalent) in architecture;
- Possession of professional licence (e.g. registered architect) from at least 10 year:
- Good command of English language.

- **Structural Engineer**, with experience in the field of static and dynamic calculation.

The competence of the professional must be demonstrated through:

- projects done in the last 10 years, regarding calculation of complex structures. The professional must demonstrate knowledge and experience in FE modelling.
- 2 projects done in the last 10 years, regarding calculation of complex structures.

The 2 projects have to be illustrated through a presentation in format A3 (maximum 5 sheets for each project, including text , figure and tables).

- Master Degree (or equivalent) in civil engineering;
- Possession of professional licence (e.g. registered engineer) from at least 10 year;
- Good command of English language.

- **Electrical and mechanical Engineer**, with experience in the field complex electrical and mechanical systems.

The competence of the professional must be demonstrated through:

- projects done in the last 10 years, regarding calculation of complex electrical and mechanical systems.
- 2 projects done in the last 10 years, regarding calculation of complex electrical and mechanical systems.

The 2 projects have to be illustrated through a presentation in format A3 (maximum 5 sheets for each project, including text , figure and tables).

- Master Degree (or equivalent) in mechanical engineering;
- Possession of professional licence (e.g. registered engineer) from at least 10 year;
- Good command of English language.

- **Geologist**, whose competence must be demonstrated through:
  - geotechnical and geological analysis done in the last 10 years, regarding complex sites, illustrated through a detailed Curriculum Vitae;
  - Possession of professional licence from at least 10 year;
  - Good command of English language.

- **Professional with experience in the management of complex projects**, whose economical and technical competence must be demonstrated through:
  - management of complex projects, with the role of coordinator, done in the last 10 years.
  - Good command of English language.

- **Architect or Engineer**, with official habilitation in security management.

The competence of the professional must be demonstrated through:

- Safety plans done in the last 10 years, regarding public or private buildings;
- 2 safety plans done in the last 10 years, regarding public or private buildings with characteristic of cultural heritage. The 2 projects have to be illustrated through a presentation in format A3 (maximum 5 sheets for each project, including text , figure and tables).
- Master Degree (or equivalent) in architecture/engineering;

- Possession of professional licence (e.g. registered architect or engineer) from at least 10 year;
- Good command of English language.

PRELIMINARY PROJECT (“SCHITA DE PROIECT”)

The preliminary project is defined by the Moldovan government's decision No. 73 of 31-01-2014 under the name of ‘schita de proiect’. It is an essential deemed to obtain the town planning certificate. For projects on cultural heritage, it must be approved by the National Council for Historic Monuments sitting in the Ministry of Education, Culture and Research.

Tasks

The preliminary project has the purpose, based on the previous analytical and documentation exercise and the recommendations of the technical expertise, to elaborate the project in all its different components (architectural, structural, installations). It must also foresee the costs and times of the execution of the works.

The preliminary project identifies the best relationship among several solutions in terms of costs and benefits for the community, in relation to the specific services to be provided.

The planning is intended:

- to ensure the satisfaction of the community needs;
- to ensure architectural and technical functional and relationship quality in the work context, with the aim of respecting the existing building, considered as “cultural heritage”;
- to ensure compliance with environmental, urban planning and the protection of cultural assets, as well as the compliance with the provisions of the legislation on the protection of health and safety;
- to ensure compliance with hydro-geological and seismic constraints as well as other existing constraints;
- to ensure energy saving, efficiency and energy recovery during the construction phase and during the future life of the building, as well as the assessment of the life cycle and the maintainability of the works;
- to ensure accessibility and adaptability in accordance with the provisions in force regarding architectural barriers.

The designer in charge will develop, in respect of the contents of the Expertise, all the necessary investigations and studies for the definition of the aspects previously listed. The designer will also realize the graphic drawings for the identification of dimensional, volumetric, typological, functional and technological characteristics of the works to be carried out and the relative economic estimates, including the choice regarding the possible division into functional lots.

The preliminary project is drawn up on the basis of the carrying out of geological, hydrogeological investigations, hydrological, hydraulic, geotechnical, seismic, historical, landscape and urban planning, verification. It must also include the assessments or any energy diagnoses of the project in progress, with reference to the containment of energy consumption and possible measures for the production and recovery of energy also referring to the economic-financial impact opera.

Deliverable

According to the decision of the Government No. 73 of 2014, the works that are part of the project sketch, partly obtained by the Technical expertise and deepened as necessary, are:

a) the historical note on the subject, if applicable;

b) the plan for positioning the object on the territory;

c) the general plan of the object (with indication of the adjacent buildings);

d) investigation of buildings / buildings with monumental status (including interior and exterior decorative elements and carpentry, construction elements, domestic fixed furnishings, etc.);

e) complete photographic documentation of the existing buildings (with architectural, technical and internal details, etc.), of the architectural surveys carried out;

f) conservation / restoration, rehabilitation / adaptation projects, consolidation or new construction project, as the case may be, developed by architects with practical experience in conservation / restoration design working on monuments, Authorized / certified in the field of historical architectural heritage;

g) the color solution of the facades.

Considering the relevance of Chisinau Circus, the Preliminary must also contain:

- general technical report: it describes all the interventions (architectural, structural and plant engineering) which also includes the evaluations related to the results of the material relief and of the deterioration, specific of the executive techniques, of the materials to be used, of the structural intervention, of the plant engineering;
- technical report: it is divided into several sections, concerning the architectural, structural, technological, geological and functional aspects. Each of them describe the several solutions developed by the designer in charge.
- Regarding the structural report, the reached level of seismic and static retrofit after the design consolidation interventions must be preventively identified in accordance with the competent authorities and declared at the end of the report;
- static and seismic verification of the building, calibrated through the dynamic test performed in the technical expertise;
- preliminary graphic elaboration of the technical solutions for the structural consolidation, installations and conservation (scale 1:100 – 1:50 - 1:20);
- first indications and provisions for the drawing up of safety plans according to the CP A.08.06:2014 and to the European directive 92/57 / EEC;
- preliminary priced bill of quantity on the basis of mapping;
- economic project outline;
- the chrono program of the intervention;
- the analysis of possible project alternatives, at least with regard to accessibility and structural consolidation.

Professional qualifications and general requirements

The Technical Expertise requires the following competences:

- **Architect**, with experience in the field of conservation of existing buildings.

The competence of the professional must be demonstrated through:

- projects done in the last 10 years, regarding public or private buildings, with characteristics of cultural heritage.
- 2 projects done in the last 10 years, regarding public or private buildings with characteristic of cultural heritage. The 2 projects have to be illustrated through a

presentation in format A3 (maximum 5 sheets for each project, including text , figure and tables).

- Master Degree (or equivalent) in architecture;
- Possession of professional licence (e.g. registered architect) from at least 10 year:
- Good command of English language.

- **Structural Engineer**, with experience in the field of static and dynamic calculation.

The competence of the professional must be demonstrated through:

- projects done in the last 10 years, regarding calculation of complex structures. The professional must demonstrate knowledge and experience in FE modelling.
- 2 projects done in the last 10 years, regarding calculation of complex structures.

The 2 projects have to be illustrated through a presentation in format A3 (maximum 5 sheets for each project, including text , figure and tables).

- Master Degree (or equivalent) in civil engineering;
- Possession of professional licence (e.g. registered engineer) from at least 10 year;
- Good command of English language.

- **Electrical and mechanical Engineer**, with experience in the field complex electrical and mechanical systems.

The competence of the professional must be demonstrated through:

- projects done in the last 10 years, regarding calculation of complex electrical and mechanical systems.
- 2 projects done in the last 10 years, regarding calculation of complex electrical and mechanical systems.

The 2 projects have to be illustrated through a presentation in format A3 (maximum 5 sheets for each project, including text , figure and tables).

- Master Degree (or equivalent) in mechanical engineering;
- Possession of professional licence (e.g. registered engineer) from at least 10 year;
- Good command of English language.

- **Geologist**, whose competence must be demonstrated through:
  - geotechnical and geological analysis done in the last 10 years, regarding complex sites, illustrated through a detailed Curriculum Vitae;
  - Possession of professional licence from at least 10 year;
  - Good command of English language.

- **Professional with experience in the management of complex projects**, whose economical and technical competence must be demonstrated through:
  - management of complex projects, with the role of coordinator, done in the last 10 years.
  - Good command of English language.

- **Architect or Engineer**, with official habilitation in security management.

The competence of the professional must be demonstrated through:

- Safety plans done in the last 10 years, regarding public or private buildings;
- 2 safety plans done in the last 10 years, regarding public or private buildings with characteristic of cultural heritage. The 2 projects have to be illustrated through a presentation in format A3 (maximum 5 sheets for each project, including text , figure and tables).
- Master Degree (or equivalent) in architecture/engineering;
- Possession of professional licence (e.g. registered architect or engineer) from at least 10 year;

- Good command of English language.

EXECUTION PHASE OF THE DESIGN

The Execution design is a main tool that regulates the technology of execution of the works on the concrete object in compliance with technical regulations, technical safety requirements, environmental safety, fire prevention rules and quality of work.

Tasks

The executive project describes and determines in every detail the works to be carried out (operational methodologies, executive techniques, materials to be used), the controls to be carried out during the construction site, the relative costs, the execution schedule.

It must be developed at a level of detail such that each element is identified in form, type, quality, size

and price. The executive project must also be accompanied by a programmed maintenance plan for the work and its parts. The executive project is subject to approval by the Council of Monuments, according to the provisions of the Governmental Decision (HG) n. 73 of 31/01/2014. The contents of the technical documentation are identified by the Moldovan legislation on constructions (NCM A07 02-2012 4802, CP A 08.06:2014 and CP A 08.05:2015) as well as in the above mentioned governmental decision. It is however considered that further specific documentation is necessary in order to guarantee the necessary quality of the intervention.

Deliverables

The executive project for the Circus must be integrated by the following groups of technical papers:

- technical-descriptive report
- specialist relations (architectural, structural, installations) ;
- graphic processes including those of structures, installations and restoration and environmental improvement in scale 1:100 – 1:50 (for plan and sections) – 1:20 – 1:10 – 1:5 (for details);
- maintenance plan of the opera and its parties;
- safety plan according to the European directive 92/57 / EEC and to the CP A.08.06:2014;
- list of unit prices and analysis of prices - metric estimate and economic framework
- time schedule and program of works;
- Special tender specifications with a description of the work and materials to be used.

The reports produced for the preliminary project must be integrated with internal and external executive details in sufficient number to fully define the work from a technical-executive point of view, drawn up to adequate scale and in order to define all the parts of the work from an economic or technological point of view.

In particular, the project must be complete with all the indications and specifications necessary to enable it,

so that it can be carried forward by another professional, different from the designer, without that further project definitions must be prepared for executive purposes. The papers are written to allow the performer a secure interpretation and execution of the work, in each of their elements.

Professional qualifications and general requirements

The Technical Expertise requires the following competences:

- **Architect**, with experience in the field of conservation of existing buildings.

The competence of the professional must be demonstrated through:

- projects done in the last 10 years, regarding public or private buildings, with characteristics of cultural heritage.
- 2 projects done in the last 10 years, regarding public or private buildings with characteristic of cultural heritage. The 2 projects have to be illustrated through a presentation in format A3 (maximum 5 sheets for each project, including text , figure and tables).
- Master Degree (or equivalent) in architecture;
- Possession of professional licence (e.g. registered architect) from at least 10 year:
- Good command of English language.

- **Structural Engineer**, with experience in the field of static and dynamic calculation.

The competence of the professional must be demonstrated through:

- projects done in the last 10 years, regarding calculation of complex structures. The professional must demonstrate knowledge and experience in FE modelling.
- 2 projects done in the last 10 years, regarding calculation of complex structures.

The 2 projects have to be illustrated through a presentation in format A3 (maximum 5 sheets for each project, including text , figure and tables).

- Master Degree (or equivalent) in civil engineering;
- Possession of professional licence (e.g. registered engineer) from at least 10 year;
- Good command of English language.

- **Electrical and mechanical Engineer**, with experience in the field complex electrical and mechanical systems.

The competence of the professional must be demonstrated through:

- projects done in the last 10 years, regarding calculation of complex electrical and mechanical systems.
- 2 projects done in the last 10 years, regarding calculation of complex electrical and mechanical systems.

The 2 projects have to be illustrated through a presentation in format A3 (maximum 5 sheets for each project, including text , figure and tables).

- Master Degree (or equivalent) in mechanical engineering;
- Possession of professional licence (e.g. registered engineer) from at least 10 year;
- Good command of English language.

- **Architect or Engineer**, with official habilitation in security management.

The competence of the professional must be demonstrated through:

- Safety plans done in the last 10 years, regarding public or private buildings;
- 2 safety plans done in the last 10 years, regarding public or private buildings with characteristic of cultural heritage. The 2 projects have to be illustrated through a presentation in format A3 (maximum 5 sheets for each project, including text , figure and tables).
- Master Degree (or equivalent) in architecture/engineering;
- Possession of professional licence (e.g. registered architect or engineer) from at least 10 year;
- Good command of English language.

- **Construction company**

By the need to foresee, for all execution phases of the interventions, a close interconnection between the restoration of the decorative apparatuses and consolidation operations on the structures , the construction company has to demonstrate its competence through:

- Possession of EN ISO 9001 or equivalent European Certification;
- Works in the last 10 years regarding public or private buildings, whose amount is at least equal to the amount of the works for the Circus for each category (structure, restoration, electrical and mechanical system);
- Both the Building site manager (Responsabil Tehnico) representing the contracting authority and the Technical Director (Dirigint de santier) of the company must be architects or engineers and must have the professional requirements requested for the elaboration of the project phase and at least a 5-year experience as building site manager or technical director on structural consolidation and rehabilitation of cultural heritage, illustrated through a detailed CV, and good command of English language.

STANDARDS AND REFERENCES

Hereafter the principal References and Standards are reported.

Further legal, regulatory and normative documents need to be identified by the Contracting Authority.

- Moldova – Law n. 721of 02.02.1996 on the quality in construction (MO n. 25/ 25.04.1996), as amended.
- Moldova – Government Decision n. 361/1996 on the assurance of quality in construction (MO n. 52 – 53/ 8.8.1996)
- Moldova - GOVERNMENT DECISION n. 936 of 16.08.2006 (MO n. 138-141/01.09.2006) as amended
- Moldova - GOVERNMENT DECISION n. 1029 of 19.12.2013 on public capital investment (MO n.. 311/27.12.2013, art. 1157), as amended;
- Law n. 1530 of 22.06.1993 on the protection of monuments (MO n. 15- 17 /02.02.2010) as amended;
- Moldova – Government Decision n. 73 of 31.01.2014 on the approval of the regulation of the national Council of Historic Monuments.
- Moldova - NCM 27.02.2012 - Construction Regulation
- European Directive 89/391/EEC of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work;
- European Directive 92/57/CEE (24.06.1992) - concerning the minimum safety and health requirements to be implemented in temporary or mobile work sites;
- Eurocodes for diagnostic investigations:
    - Qualification for personnel in charge to perform on site non-destructive test: EN 9712:2012
    - Sclerometric test: EN 12504-2:2012
    - Ultrasonic test: EN 12504-4:2005
    - Sample and compression test on concrete: EN 12504-1:2009
    - Pull-out test: EN 12504-3:2005
    - Windsor test: ASTM C 803
    - Visual inspection: EN 13018:2004
    - Non destructive test – General terms: EN 1330-1:2000
    - Magnetoscopic test: EN 1330-7:2005
    - Geotechnical test: EN 1997-2:2007 - 2